What is Crime Mapping? - Briefing Book

I. Why Map Crime?

Crimes are human phenomena; therefore, their distribution across the landscape is not geographically random. For crimes to occur, offenders and their targets - the victims and/or property - must, for a period of time, exist at the same location. Several factors, from the lure of potential targets to simple geographic convenience for an offender, influence where people choose to break the law. Therefore, an understanding of where and why crimes occur can improve attempts to fight crime. Maps offer crime analysts graphic representations of such crime-related issues.

Mapping crime can help law enforcement protect citizens more effectively in the areas they serve. Simple maps that display the locations where crimes or concentrations of crimes have occurred can be used to help direct patrols to places they are most needed. Policy makers in police departments might use more complex maps to observe trends in criminal activity, and maps may prove invaluable in solving criminal cases. For example, detectives may use maps to better understand the hunting patterns of serial criminals and to hypothesize where these offenders might live.

Using maps that help people visualize the geographic aspects of crime, however, is not limited to law enforcement. Mapping can provide specific information on crime and criminal behavior to politicians, the press, and the general public.

II. Mapping Crime Locations

Some of the most helpful maps for those persons who patrol and investigate crimes simply indicate where incidents have occurred. Prior to recent technological advances, police typically placed pushpins in wall maps to examine the spatial distribution of crime locations. Modern geographic information system (GIS) software, however, allows police to produce more versatile electronic maps by combining their databases of reported crime locations with digitized maps of the areas they serve.

This map shows the locations of all homicides that occurred in Washington, DC, in 1994 and 1995. Of the total 756 murders that occurred over the two-year period, only one occurred west of Rock Creek.

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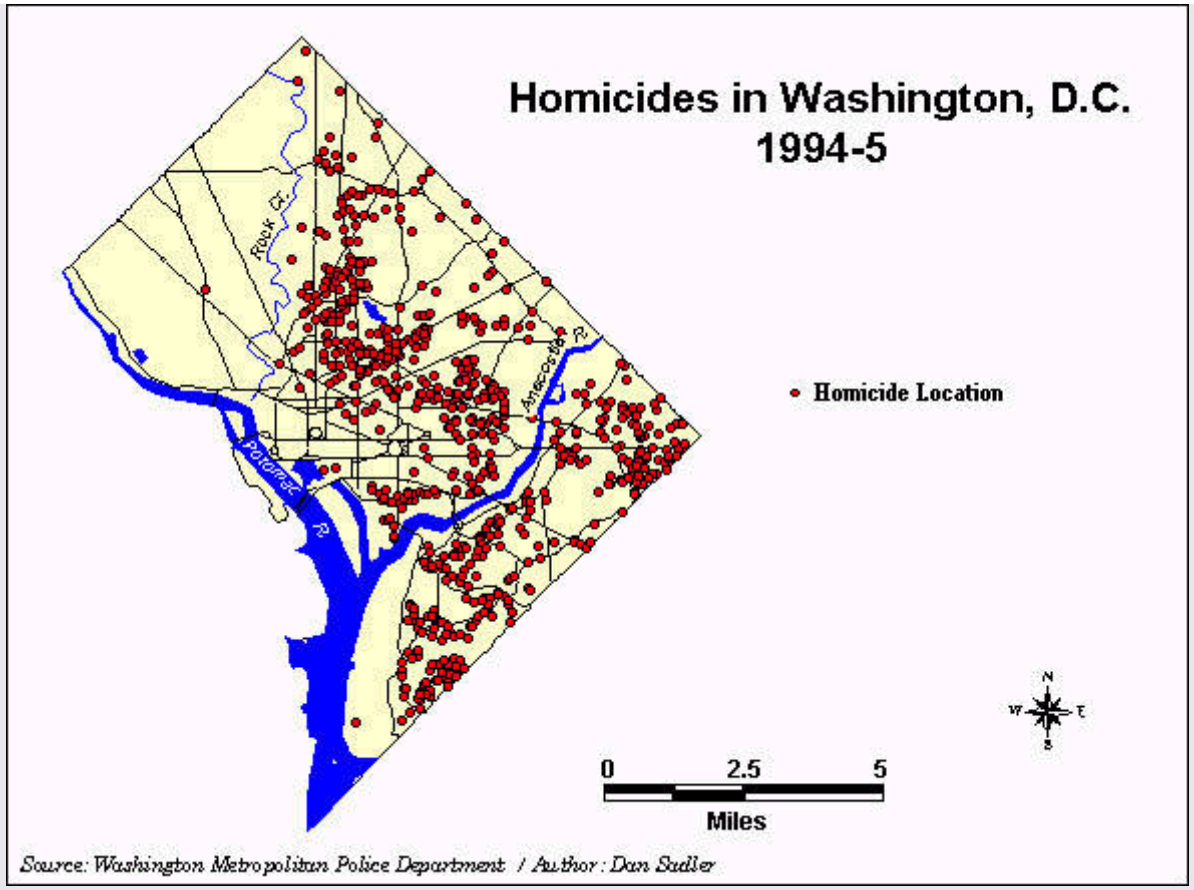

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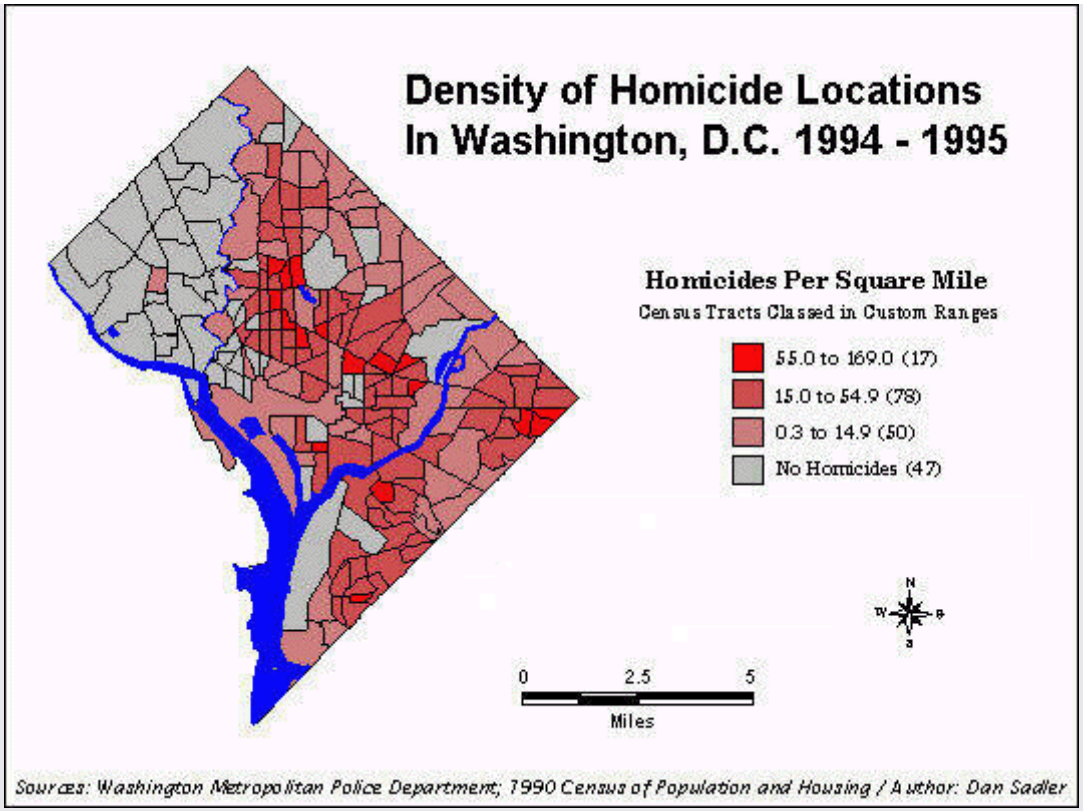
III. Density of Crimes

The same GIS software used to map crime locations can also be used to calculate crime density values, such as the number of crimes per square mile. These density values can be used to create a choropleth map, which uses color to represent different values among land units within the study area, such as police precincts, city voting districts, or census tracts. Density maps offer the map user a broader look at where crimes occur without his having to interpret a large number of individual locations.

Here, the same data used to produce the map of homicide locations on the previous page were used to calculate densities of the crime within census tracts in Washington, DC. The gray areas are census tracts in the city where no homicides occurred in 1994 and 1995. The solid red tracts ranked highest in density of homicides, ranging 55 to 157 homicides per square mile. (Census tracts are generally smaller than a square mile, so the actual numbers of homicides occurring in each is often considerably less than its density value in the map legend.)



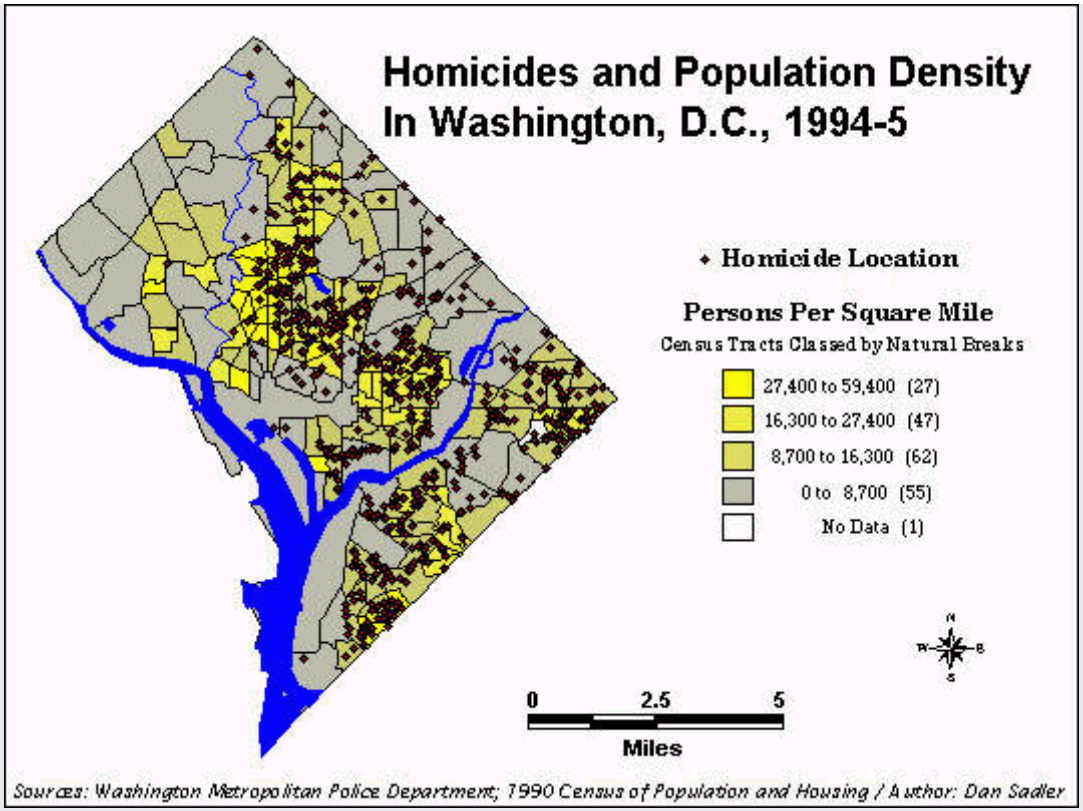
IV. Combining Data from Multiple Sources

Spatial data from sources other than law enforcement can be very relevant in crime analysis. The following three maps combine data from the Washington Metropolitan Police Department with U.S. Census data to examine the location of homicides with respect to demographic factors.

The first choropleth map shows some correlation of densely populated census tracts, highlighted in yellow, with large numbers of homicides, represented individually by red dots. Generally, the largest clusters of homicides appear to be within or nearby the more densely populated areas.

The second map examines homicides and the percentage of housing units that are vacant in each census tract. A large percentage of vacant homes can be an indicator of poverty in an area; vacant buildings can also relate more directly to certain crimes by serving as places where illegal activity can take place.

The third map compares homicides in 1994 with the percentage of persons in each tract that fall 50% or more below the poverty level. Generally, more homicide incidents appear to have occurred in the poorer tracts.

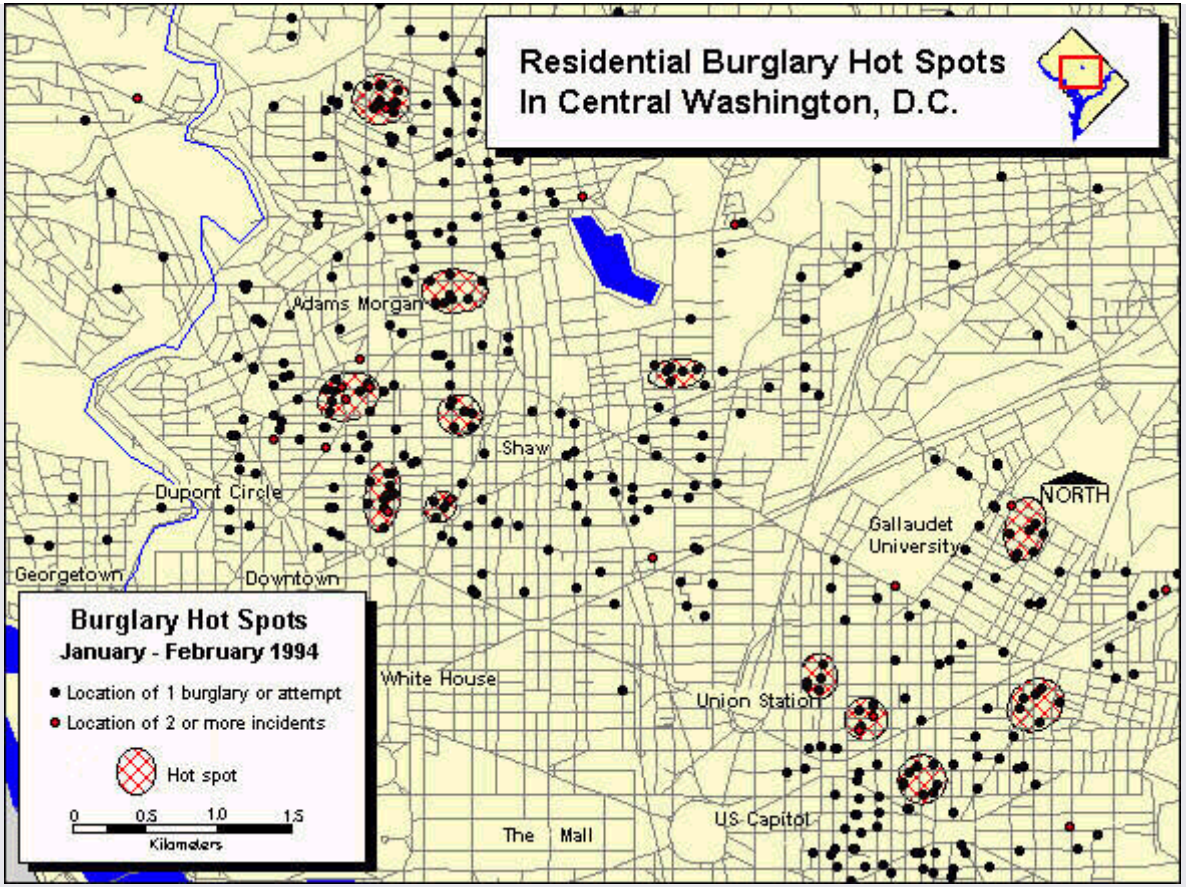


V. Hot Spots

Today, police departments frequently use computer-mapped crime locations to delineate hot spots, or areas with high concentrations of crime. Highlighting such areas helps police direct patrols where they are most needed, thereby optimizing the deterrent effect of police presence. Although concentrations of crime locations may be discernible on a relatively simple point-map of crime locations, multiple crimes occurring at a single address may deceivingly be represented by a single point on such a map. Hot spot analysis is frequently performed using special software, such as the Spatial and Temporal Analysis of Crime (STAC) program developed by the Illinois Criminal Justice Information Authority, which draws ellipses based on the densest concentrations of mapped incidents.

This map shows locations of residential burglaries and attempted burglaries that occurred over a two-month period in Washington, DC. Using this data, elliptical hot spots were drawn to highlight places of approximately a 1- to 4-block-size where concentrations of the crimes occurred.

[Note: hot spot ellipses were drawn by hand for illustrative purposes.]

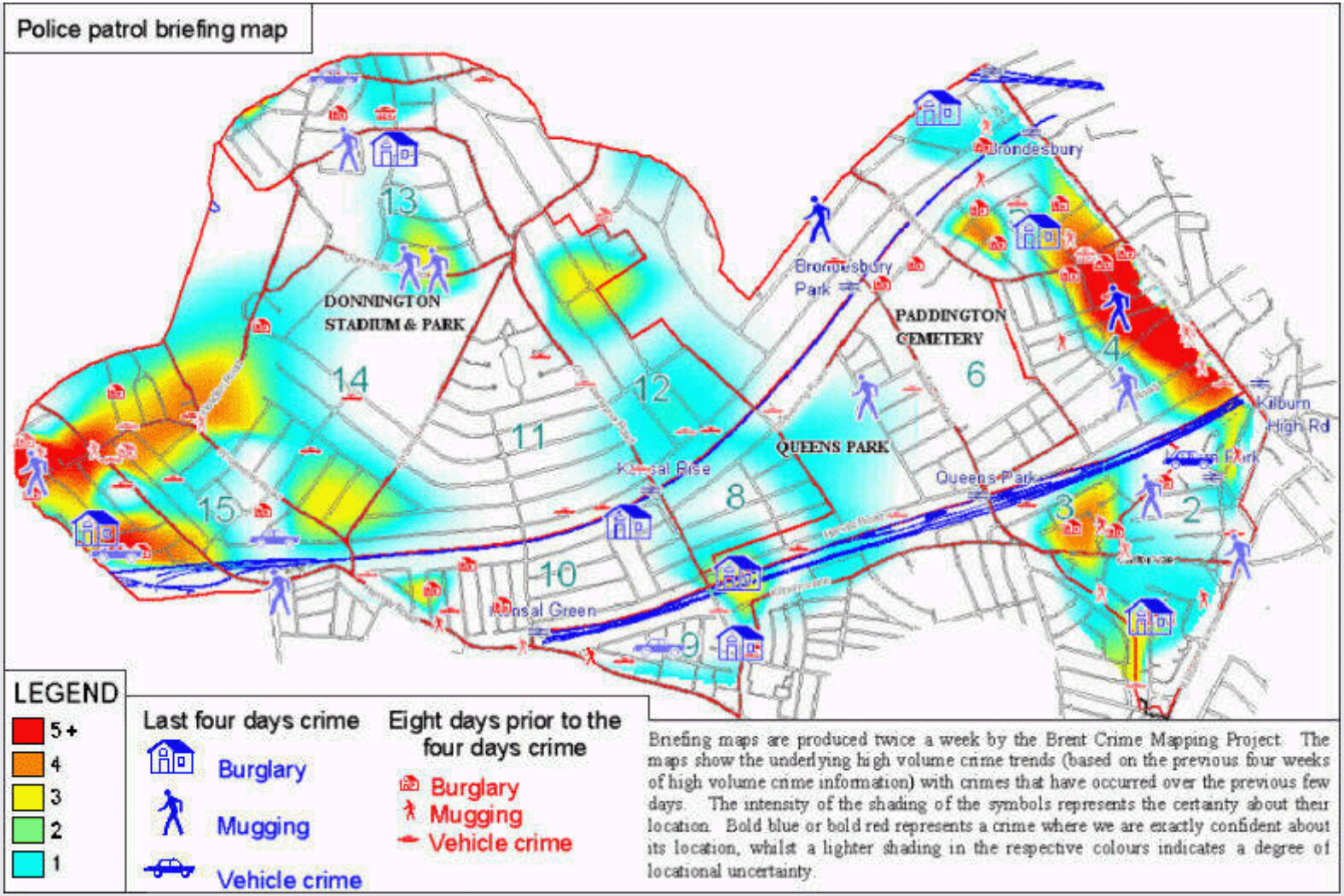


VI. Keeping Patrols Up to Date

Patrols in many departments are briefed regularly with the aid of maps on recent crime trends. In addition to crime location and hot spot maps, some departments provide patrol officers with several other types of spatial information.

Shown here is a sample patrol-briefing map, produced biweekly for police in the Borough of Brent, London, U.K. This map not only shows the locations of three types of crimes over a 12-day period, but also highlights the more recent incidents in larger, red icons. Additionally, icons representing crimes whose locations have been positively identified are shaded with the boldest colors; locations that had to be approximated receive lighter shading to signify the decreasing certainty of their location. The gradient shading in the background indicates the crime trends of the previous four weeks.

Map produced by the Brent Crime Mapping Project (Chainey, 1997).



VII. Mapping and Closed Circuit Television

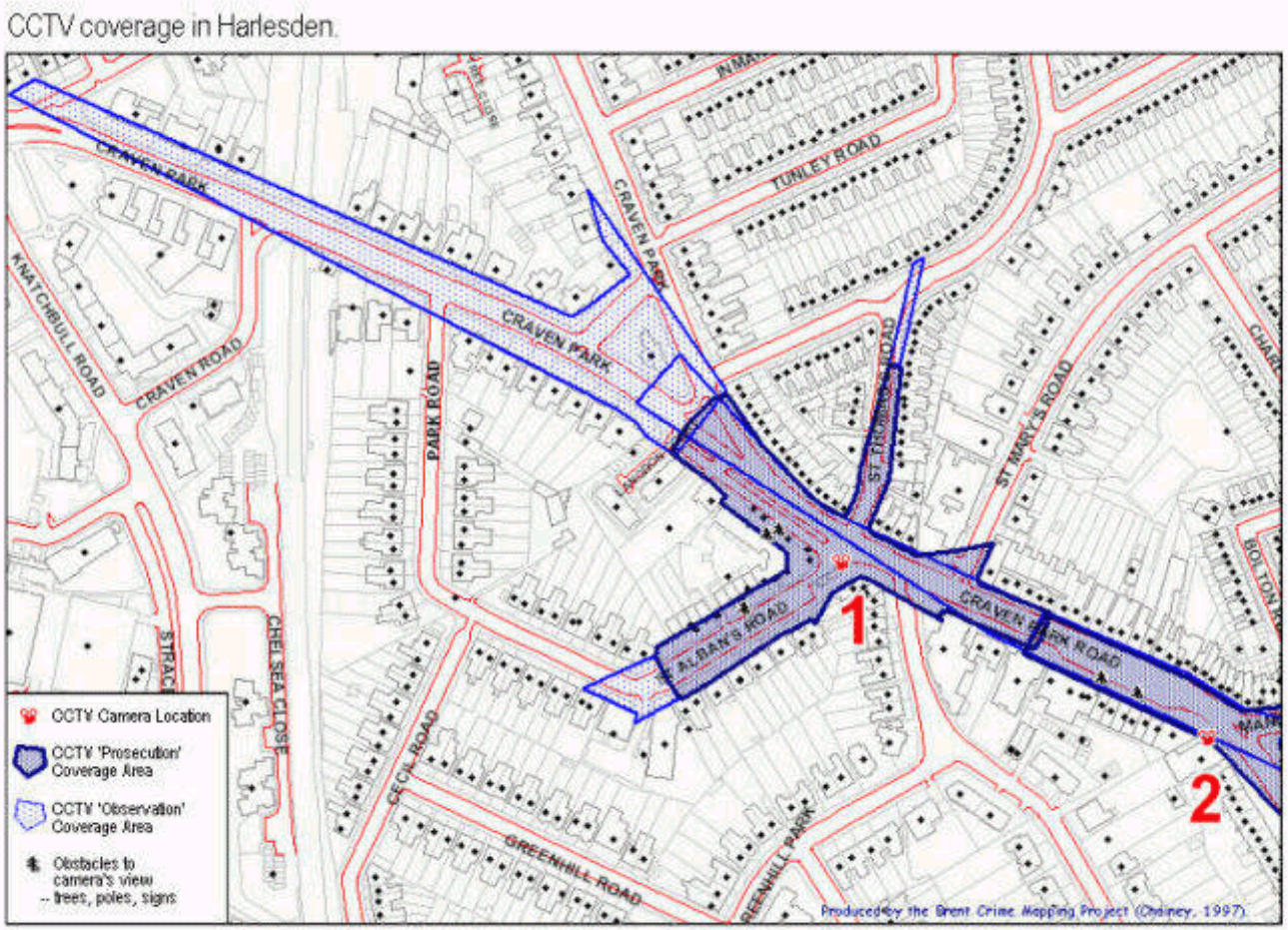
Some police departments in the United States are beginning to implement closed circuit television (CCTV) cameras that are strategically positioned in public areas. This tool for crime prevention, investigation, and evidence collection is used extensively by law enforcement in Great Britain. The tasks of placing cameras where they can be most helpful and then understanding the limits of their use can be facilitated through the use of maps.

This map shows a small portion of police CCTV coverage in Harlesden, an area within the London Borough of Brent. On this graphic, blue shading highlights areas within view of two of the CCTV cameras. Inside that area, the darker blue shading shows the region within each camera's view for which offenders can be legally identified; film capturing images of suspects within this region can be used as prosecuting evidence. Icons represent the locations of trees, signs, and other potential obstructions to the camera's view.

Maps such as this one helped planners of the Harlesden CCTV project choose intersections for the cameras that

optimized the visual coverage -- especially for places identified by police as street crime hot spots. The CMRC has been asked not to post maps displaying the entire police CCTV coverage in the city because criminals could potentially use such information to avoid being sighted by the camera system.

Produced by the Brent Crime Mapping Project (Chainey, 1997).

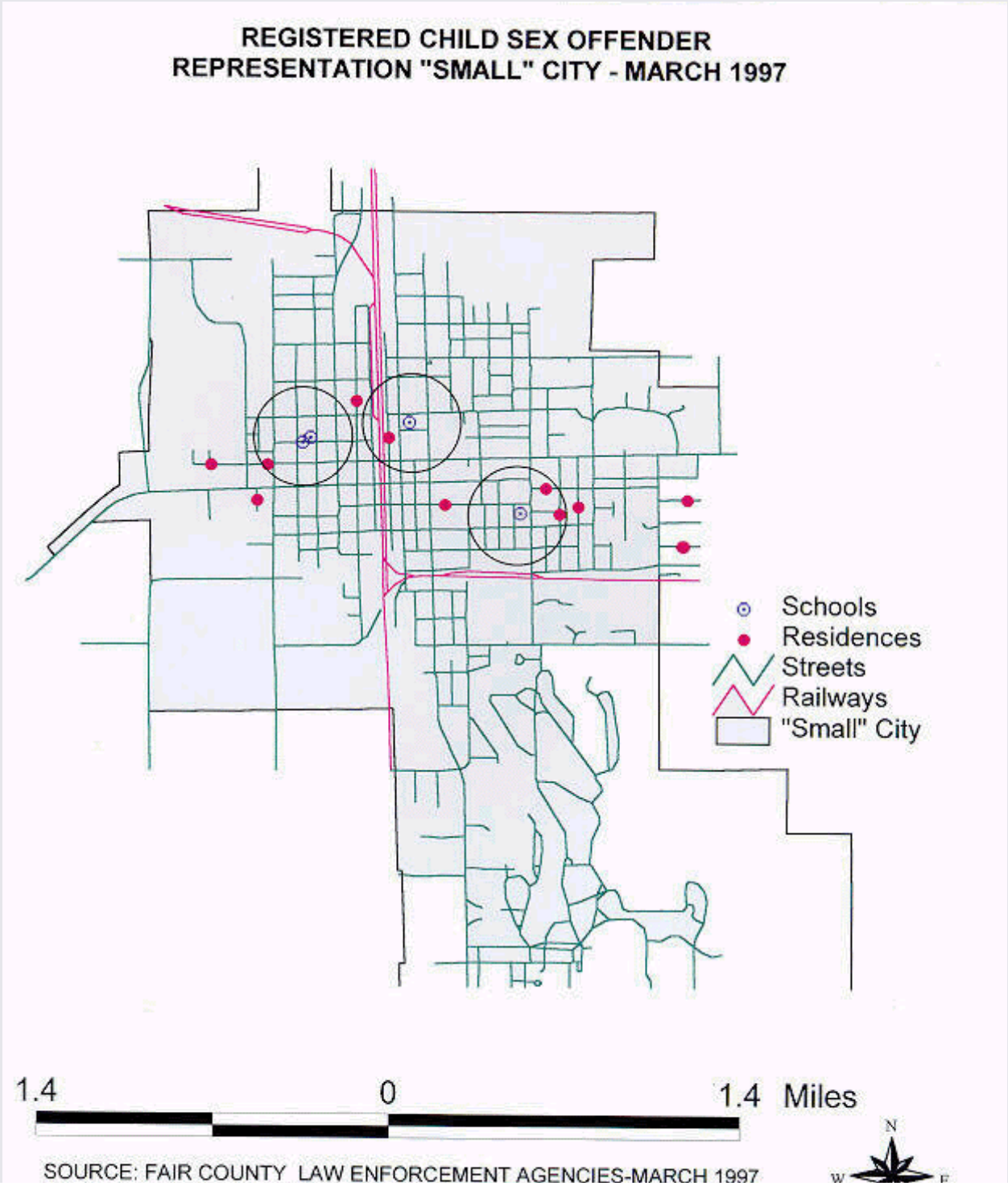


VIII. Proximity

The applications of spatial crime analysis extend beyond the production of maps displaying crime locations for police; they provide analytical functions of interest to the general community as well.

This map of an anonymous small town with a population slightly above 6,500, for example, locates the residences of registered child sex offenders whose addresses have been made public by local government. These locations were compared with the locations of the town's schools. 1000-foot buffers were drawn around the schools to make it easier to observe how close the known offenders live to these potential target areas. Four of the twelve total offender

residences fall within the buffered school zones on the map, and several of the others live just outside their perimeters.



NOTE: THE BUFFER CONTAINS 1000FT OF THE AREA.
SUBMITTED BY PRIYAMVADHA SRINIVASAN. 03/20/97

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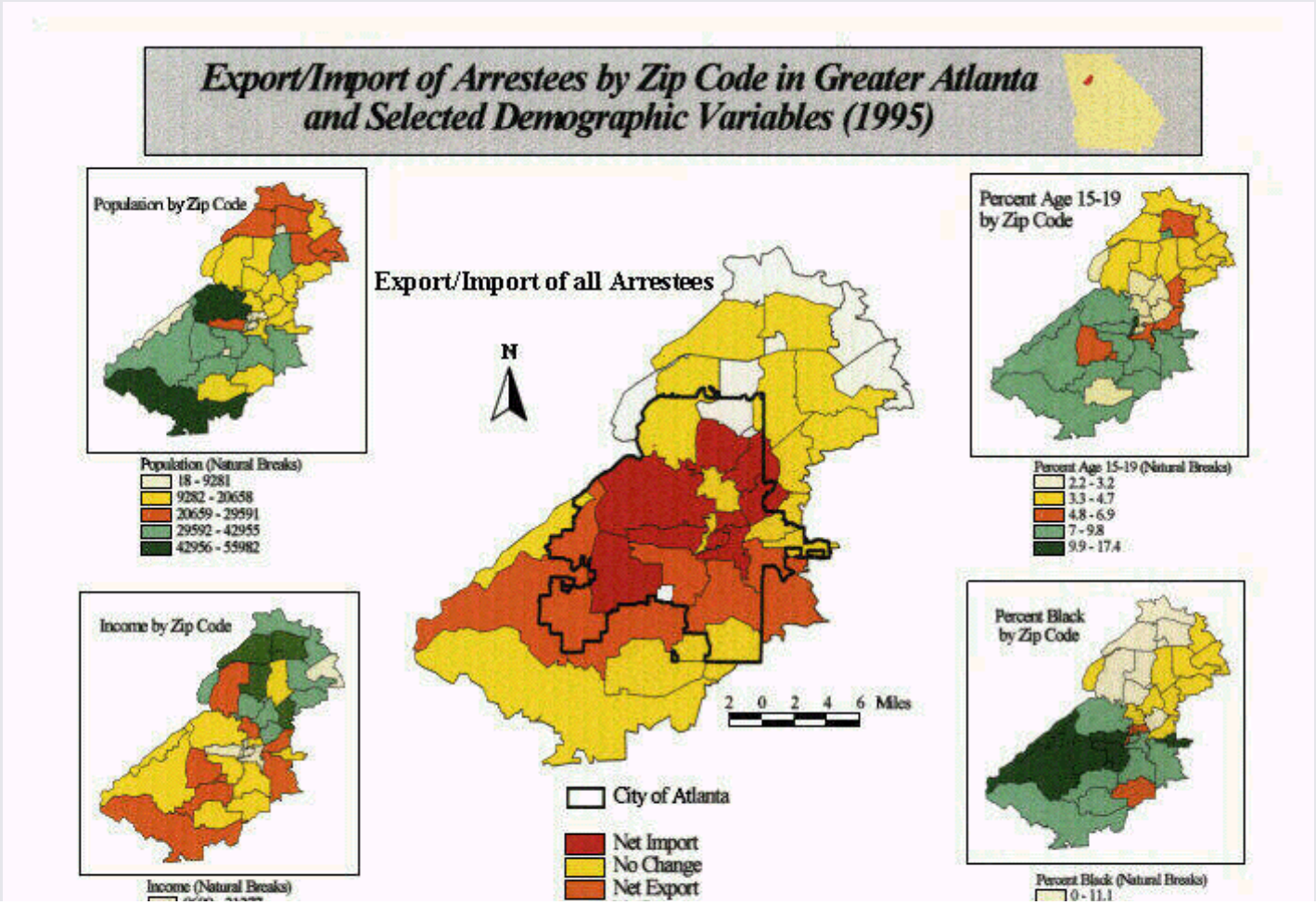
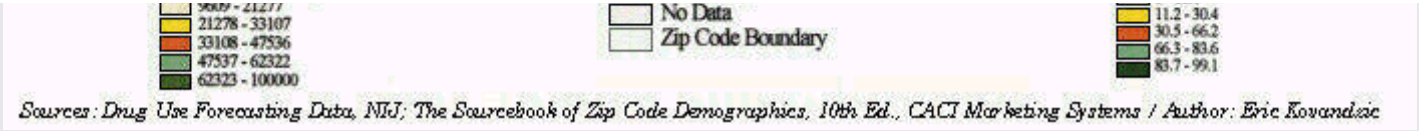
IX. The Commute of Offenders

This map of Atlanta and its vicinity investigates where offenders tend to commit crimes in relation to their residences and compares this data with demographic factors.

The large map at the center uses data obtained through NIJ's Drug Use Forecasting (DUF) project, which includes the zip codes of arrestees and those of the locations where they committed crimes. For each zip code, the number of arrestee residences and the number of crime locations were calculated. An export/import index was then calculated by subtracting the total number of arrestee locations in each zip code from the total number of arrestee residences. Each zip code was then labeled as either a net importer or a net exporter of offenders, and areas for which the two numbers were relatively close were labeled as "No Change."

The four smaller choropleth maps in the corners provide a comparison of the arrestee data with census variables.





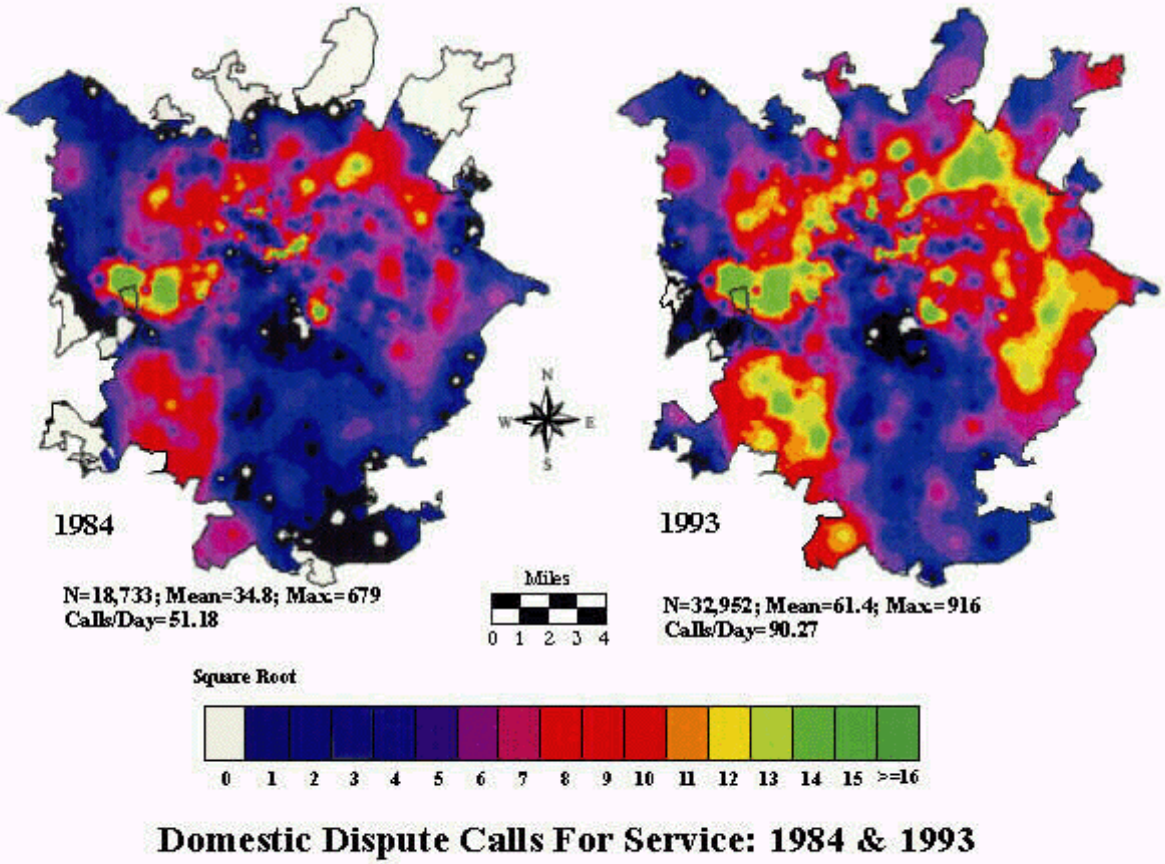
Sources: Drug Use Forecasting Data, NIJ; The Sourcebook of Zip Code Demographics, 10th Ed., CACI Marketing Systems / Author: Eric Kovandzic

X. Interpolating Crime Data and Isopleth Maps

To spot geographic trends more easily, mapping software can interpolate crime data for locations between the places where the events actually occurred and create an isopleth map. This type of map represents the data through color-coded classes, just as with choropleth maps, but eliminates the need for figures to be calculated within boundaries that are not related to crime, such as those of political jurisdictions or census tracts. Basically, by treating crime data as if it occurred continuously over the surface of an area, interpolated maps highlight specific places with high concentrations of crime events without regard to unrelated land units.

Here, interpolation serves as a convenient way to observe change over time. The two maps interpolate the origins of domestic dispute calls for service in Charlotte, NC, for 1984 and 1993. The "tie-dye" effect of this map marks areas with the highest rates of calls in green and yellow. Comparison of the two maps reveals a dramatic increase in domestic dispute calls for the entire city over the 9-year period, as both new high-rate areas appeared and previous high-rate areas grew considerably in size. The general increase in domestic dispute calls in Charlotte, as demonstrated on the map, may also reflect the rapid population growth of the city over that time period.

NOTE: Both maps use the 1993 boundary of Charlotte, so areas that were annexed by the city after 1984 contain no data for that year and appear as blank spaces on the map.



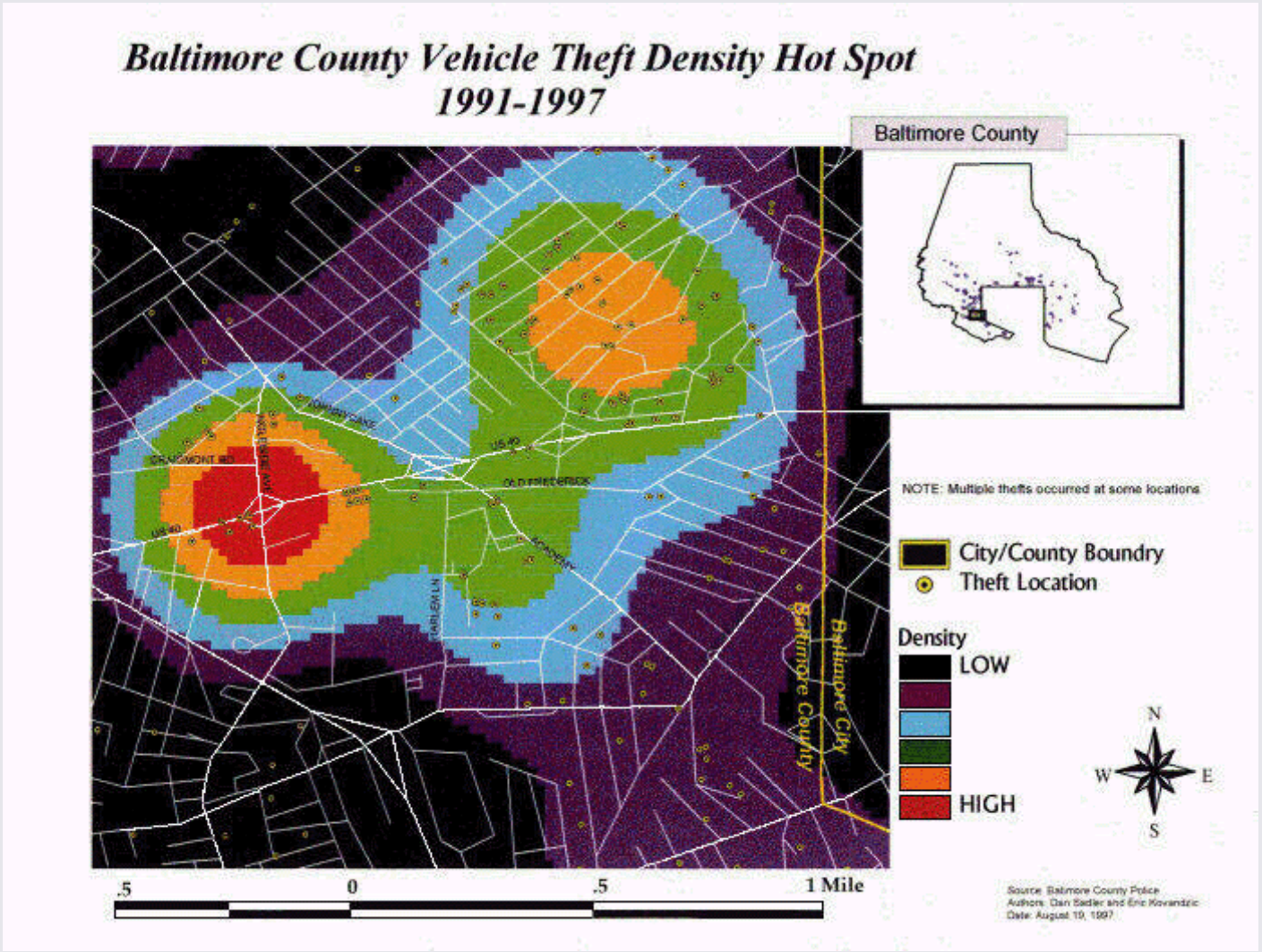
Domestic Dispute Calls For Service: 1984 & 1993

XI. A Closer Look at a Hot Spot

Like the previous map, this density map of auto thefts in Baltimore County treats crime data as continuous variables. The map zooms in on a small area that stands out as a hot spot for the entire county, shown in the inset map. It exemplifies how mapping hot spots can reveal information that may not be apparent on maps that simply plot crime locations.

At first glance, the brightly colored, "hot" areas may not appear to include a larger concentration of theft locations than other areas on the map. However, these areas represent where a larger number of crimes occurred per square mile; this method takes into account addresses where multiple incidents occurred. At some of the theft locations within the red area, for example, more than ten automobiles were stolen over the six-year study period.

Also, the theft locations on this map demonstrate that not all areas falling within the hot spot region on the map are actually "hot." Although thefts only occurred on one block within the red area, adjacent areas that were void of thefts from 1991 to 1997 are situated close enough to multiple-theft addresses that they classify as having a high number of thefts per square mile.



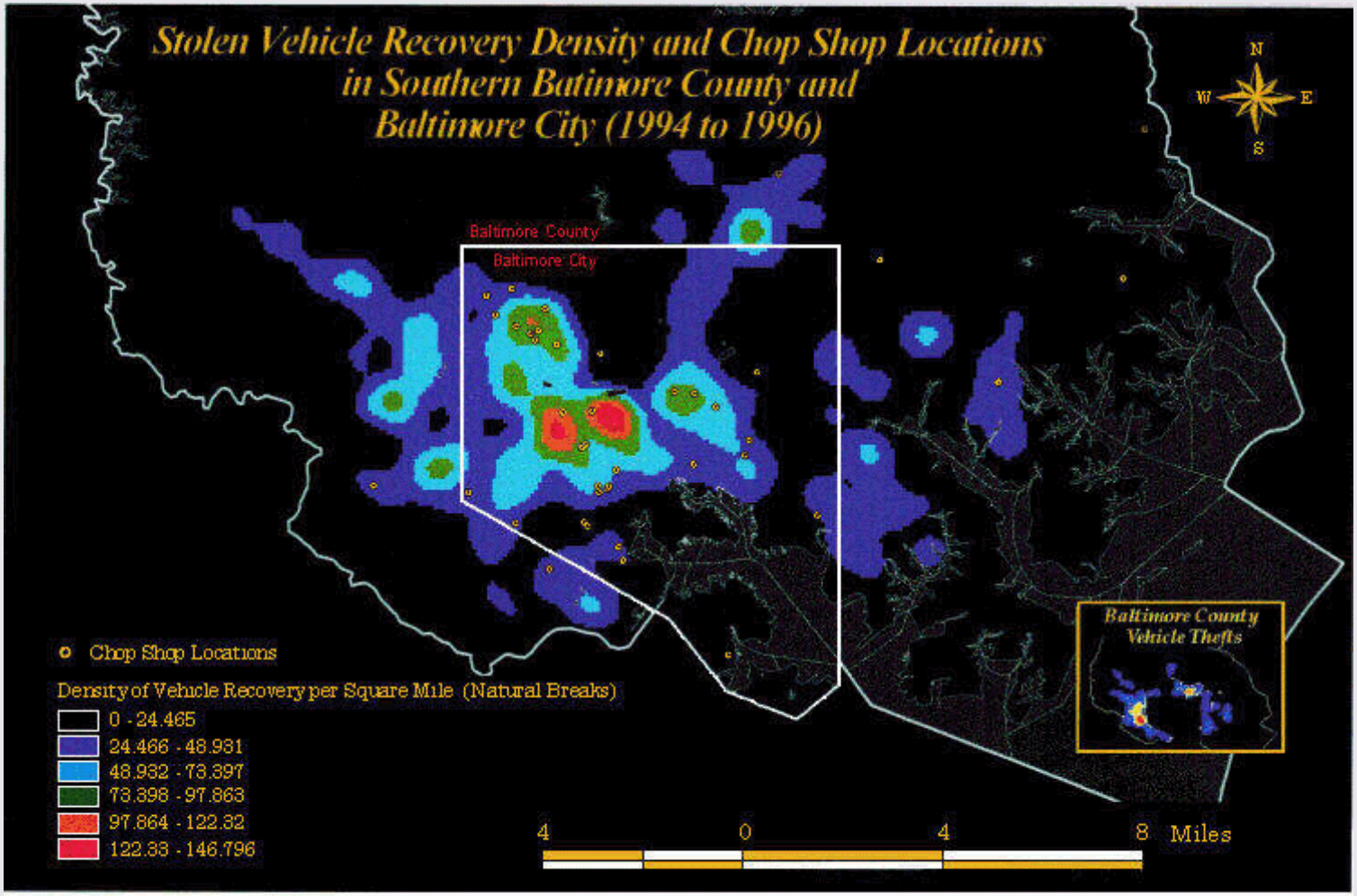
XII. Recovery Locations

Many crime analysts consider the locations where stolen vehicles are recovered to be more relevant in solving crimes than the locations from where they are stolen. Unless a thief has an alternate mode of transportation, he will likely leave a stolen automobile close to some desired destination -- quite possibly a chop shop, where stolen cars are stripped down for parts.

The density map below shows the number of automobiles recovered per square mile that had originally been stolen in Baltimore County (see previous map). Interestingly, the densest areas are in neighboring Baltimore City, indicating that many cars stolen in the suburbs are later brought into the city.

Also displayed on this map are the locations of chop shops discovered by police. These are also concentrated in Baltimore City, and generally appear to be located relatively close to the high-density recovery areas on the map. For

example, the green and yellow "hot" recovery area near the northwestern corner of the city surrounds 6 chop shops and is in the vicinity of several others.



XIII. Tracking Serial Offenders

The graphic below illustrates how crime maps can aid in the apprehension of serial criminals. These maps, called criminal geographic targeting (CGT) models, help investigators in their attempt to determine where serial criminals most likely reside given the locations of their crimes.

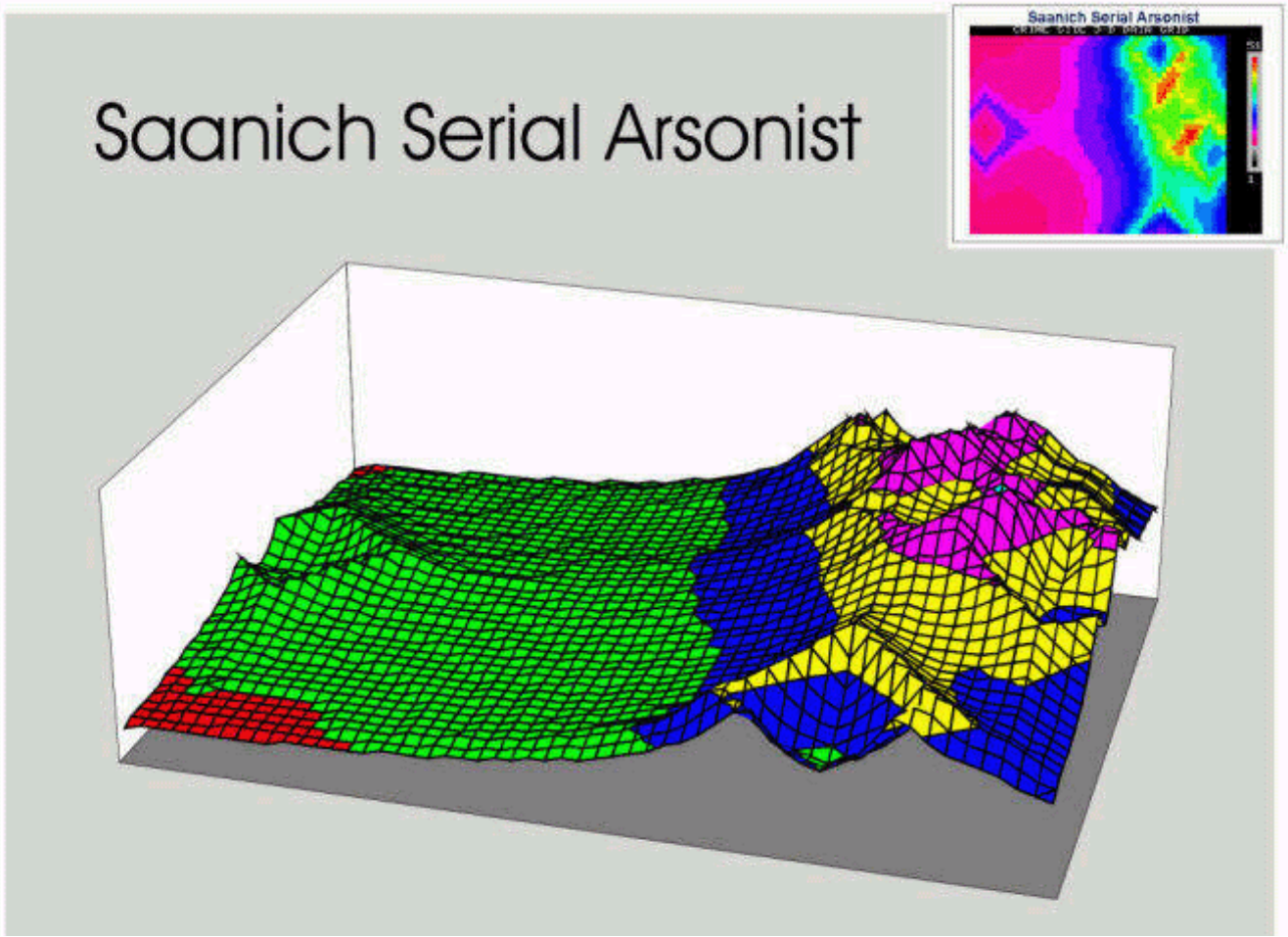
The CGT model adheres to the assumption that a distance relationship exists between the residences of serial offenders and where they chose to commit their crimes. Serial criminals, like everybody else, conduct their routine activities - traveling to and from work, shopping, etc. - within a certain space with which they have become familiar. Within this routine activity space, most people identify with a single anchor point, or place of central importance in

their lives, usually the home. The CGT model assumes that serial criminals commit their crimes within their areas of routine activity, but at the same time they are careful not to conduct this activity in the immediate proximity of their residences.

A crime analyst using a CGT model would delineate a hunting area, the region where serial offenders seek out or encounter potential victims. With the aid of special software, each point within this area is assigned a probability of being the residence of the offender. If crime analysts have a significant number of crime locations with which to work, a serial offender's residence can be narrowed down to a small number of probable locations using such a CGT model.

The following map is a three-dimensional map, with the vertical axis representing the probability that each location is the residence of the offender. The "peaks" on the map are the most probable locations and correspond with the red and yellow areas on the smaller, two-dimensional inset map in the top right corner. A crime analyst would then overlay this two-dimensional map onto a street map of the area. After comparing the CGT map with other geographic factors, such as land use, police can use the map to concentrate their efforts in certain high-probability areas.

Source: Rossmo, D.K. (1995). "Place, Space, and Police Investigations: Hunting Serial Violent Criminals." In J.E. Eck and D. Weisburd (Eds.), Crime and Place, Crime Prevention Studies Volume 4. Monsey, NY: Criminal Justice Press.



Author: D. Kim Rossmo