
4

Introduction to Crime Mapping

Ever since maps have been available that depict the geographic features of communities, such as streets and city boundaries, police departments have used such maps to determine patrol areas and emergency routes as well as to assist patrol officers in finding specific addresses. Police departments have also mapped crime, a process that, until recently, involved the manual placement of pins on hand-drawn wall maps. This chapter discusses the emergence of computerized crime mapping as a tool for conducting crime analysis. It begins with an introduction to key terms and then describes basic concepts before presenting a history of crime mapping and information on the field's current status and career paths.

Definitions: GIS and Crime Mapping

A **geographic information system (GIS)** is a powerful software tool that allows the user to create any kind of geographic representation, from a simple point map to a three-dimensional visualization of spatial or temporal data. For the purposes of this book, the definition of a GIS is as follows:

A GIS is a set of computer-based tools that allows the user to modify, visualize, query, and analyze geographic and tabular data.

A GIS is similar to a spreadsheet or word processing program in that the software provides a framework and templates for data collection, collation, and analysis, and it is up to the user to decide what parts of the system to use and how to use them. A GIS does more than enable the user to produce paper maps; it also allows him or her to view the data behind geographic features, combine various features, manipulate the data and maps, and perform statistical functions.

Crime mapping is a term used in policing to refer to the process of conducting spatial analysis within crime analysis. For the purposes of this book, the definition of crime mapping is as follows:

Crime mapping is the process of using a geographic information system to conduct spatial analysis of crime problems and other police-related issues.



Figure 4.1 Relationship of Crime Mapping to Crime Analysis

Clarifying where different types of crime and other incidents occur is one of the many important functions of crime analysis. Because of the unique nature of the software used and the prominence of geographic data in crime mapping, this type of analysis is often discussed as though it is distinct from crime analysis; in reality, however, crime mapping is a subdiscipline of crime analysis. Crime mapping serves three main functions within crime analysis:

1. It facilitates visual and statistical analyses of the spatial nature of crime and other types of events.
2. It allows analysts to link unlike data sources together based on common geographic variables (e.g., linking census information, school information, and crime data for a common area).
3. It provides maps that help to communicate analysis results.

Crime mapping is complementary to all forms of crime analysis in that it plays an important part in almost every analysis. As Figure 4.1 illustrates, crime mapping does not stand alone; rather, it is a process that occurs within the larger process of crime analysis. The following are some examples of how crime mapping is used within the three types of crime analysis that are the focus of this book:

- In *tactical crime analysis*, crime mapping is used to identify immediate patterns for crimes such as residential and commercial burglary, auto theft, and theft from vehicles. For example, spatial analysis of auto theft incidents may reveal clusters of activity at specific locations that might indicate a crime pattern.

- In *strategic crime analysis*, crime mapping is utilized in long-term applications to analyze the relationship between criminal activity and indicators of disorder, such as a high volume of vacant property or disorder calls for service; to assist in geographic and temporal allocation of resources, such as patrol officer scheduling and determination of patrol areas; to examine patterns of crime at or around specific locations, such as schools, bars, or drug treatment centers; to calculate crime rate information, such as numbers of residential burglaries per household; and to incorporate crime data with qualitative geographic information, such as information on teenage hangouts, student pathways to school, or drug and prostitution markets.
- In *administrative crime analysis*, crime mapping is a valuable tool used by police, researchers, and media organizations to convey criminal activity information to the public. Web sites operated by police departments and news organization routinely post maps that depict areas of crime, along with corresponding tables and definitions. For example, a police agency can reduce citizen requests for neighborhood crime information by placing monthly or weekly crime maps on a Web site that members of the public can access using computers in their homes or at the local library.

Geographic Features

A geographic information system translates physical elements in the real world—such as roads, buildings, lakes, and mountains—into forms that can be displayed, manipulated, and analyzed along with police information such as crime, arrest, and traffic accident data. A GIS uses four types of features to represent objects and locations in the real world; these are referred to as point, line, polygon, and image features (for a discussion of the attribute data behind these features, see Chapter 6).

Point Features

A **point feature** is a discrete location that is usually depicted on a GIS-generated map by a symbol or label. A point feature is analogous to a pin placed on a paper wall map. A GIS uses different symbols to depict the locations of data relevant to the analysis, such as crimes, motor vehicle accidents, traffic signs, buildings, police beat stations, and cell phone towers. Figure 4.2 shows circles on the map that could represent any of these types of locations.

Line Features

A **line feature** is a real-world element that can be represented on a map by a line or set of lines. The lines in Figure 4.2, for example, represent streets. Other types of line features include rivers, streams, power lines, and bus routes.

40 INTRODUCTION

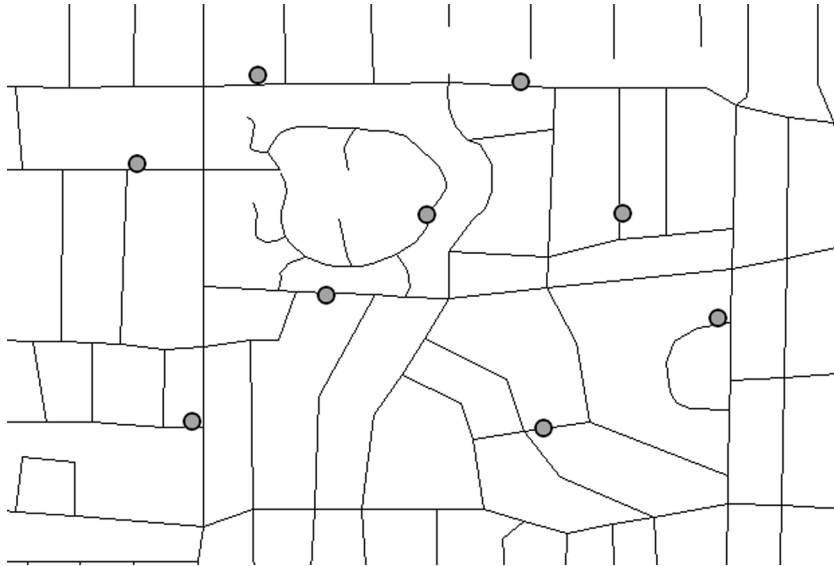


Figure 4.2 Point and Line Feature Example

Polygon Features

A **polygon feature** is a geographic area represented on a map by a multisided figure with a closed set of lines. Polygons can represent areas as large as continents or as small as buildings; in GIS-generated maps they may be used to depict county boundaries, city boundaries, parks, school campuses, or police districts. The five polygons in Figure 4.3 might represent police districts in a city.

Image Features

An **image feature** on a GIS-generated map is a vertical photograph taken from a satellite or an airplane that is digitized and placed within the appropriate coordinates. Such photos, which may appear in black and white or color, show the details of streets, buildings, parking lots, and environmental features (landscaping). Figure 4.4 is an example of an image feature, an aerial photograph of a residential neighborhood.

Types of Crime Mapping

Several types of mapping are used routinely in crime analysis. This section provides a brief introduction to the various types of crime mapping to set the stage for the chapters that follow, which discuss the creation of maps and their application to crime analysis in more detail.

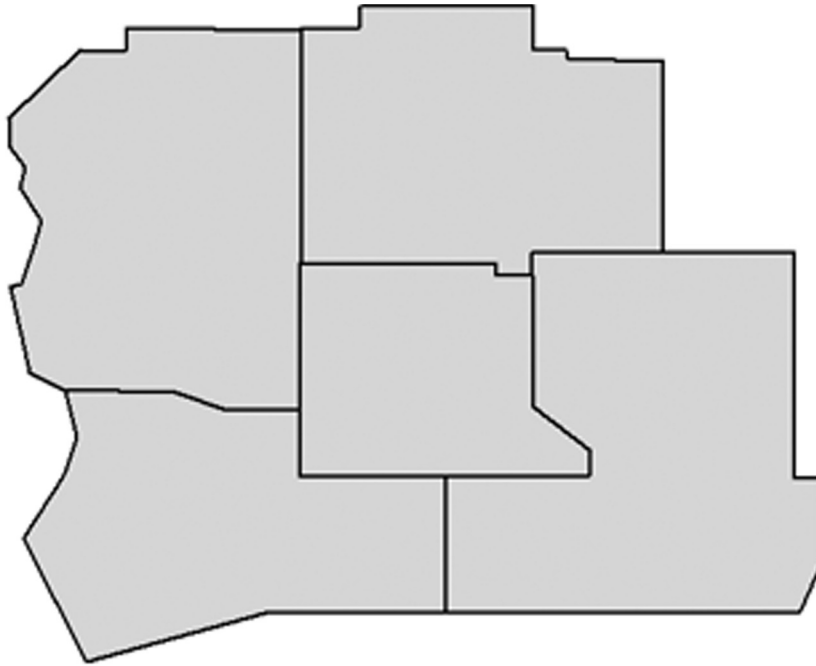


Figure 4.3 Polygon Feature Example



Figure 4.4 Image Feature Example

SOURCE: Photo courtesy of the Chula Vista (California) Police Department.

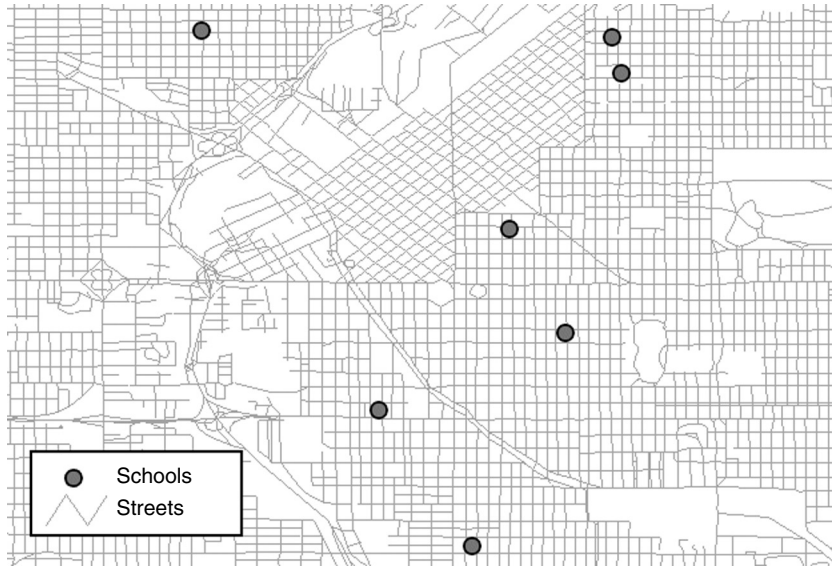


Figure 4.5 Single-Symbol Mapping Example

Single-Symbol Mapping

In **single-symbol maps**, individual, uniform symbols represent features such as the locations of stores, roads, or states. Figure 4.5 is an example of a single-symbol map showing school locations and streets.¹ An important thing to keep in mind about single-symbol maps is that a GIS places all points on such a map that share the same address directly on top of one another, making it impossible for the map to show how many points there really are. For example, in the map shown in Figure 4.5, if a middle school and elementary school share the same address, the GIS will have placed two gray circles in the same spot, so there is no way someone looking at the map can see all the schools in the area. This drawback of single-symbol mapping is particularly relevant for the mapping of crime and other police data, because crime and other police-related incidents often occur repeatedly at particular locations. Because of this, crime analysts use single-symbol mapping primarily to display geographic information in which there is no overlap; they employ other types of maps to convey information about multiple incidents at particular locations.

In addition, single-symbol maps are not useful when analysts are dealing with large amounts of data. Imagine the map in Figure 4.5 with the locations of 100 schools marked. The points would overlap, and the map would be difficult to read. Thus analysts use single-symbol maps primarily when they are working with relatively small amounts of data that do not overlap. Police agencies also often use single-symbol maps to communicate the locations of crimes within patterns to police personnel. (For numerous examples of how single-symbol maps are used in tactical crime analysis, see Chapter 9.)



Figure 4.6 Buffer Map Example: One Buffer

Buffers

A **buffer** is a specified area around a feature on a map. Buffers can be set at small distances, such as 50 feet, or larger distances, such as 500 miles, depending on the purpose and scale of the map. Buffers help in crime analysis by illustrating the relative distances between features on a map. The example map in Figure 4.6 shows a park (polygon feature) with a 500-foot buffer, which could be used to show whether drug arrests were made within 500 feet of the park.

Buffers can also be used as polygons for data aggregation and comparison. Figure 4.7 shows two buffers (500 feet and 1000 feet) around nightclubs (point features), which analysts could use to compare incidents directly around the nightclubs to those farther out to see whether the activity has a spillover effect on surrounding neighborhoods.

Graduated Mapping

Crime analysts often use **graduated maps**—that is, maps in which different sizes or colors of features represent particular values of variables. Figures 4.8 and 4.9 are general examples of graduated size and graduated color maps, respectively (for discussion of specific techniques for creating these maps, see Chapter 12.)

In a graduated size map, the sizes of the symbols used for point and line features reflect their value. As noted above, single-symbol maps are not appropriate for displaying data about crimes that occur at the same locations repeatedly. Analysts use graduated size maps for this purpose, because these maps can account for multiple incidents at the same locations. However, like single-symbol maps, graduated size maps are subject to overlapping points if too many data are analyzed at once.

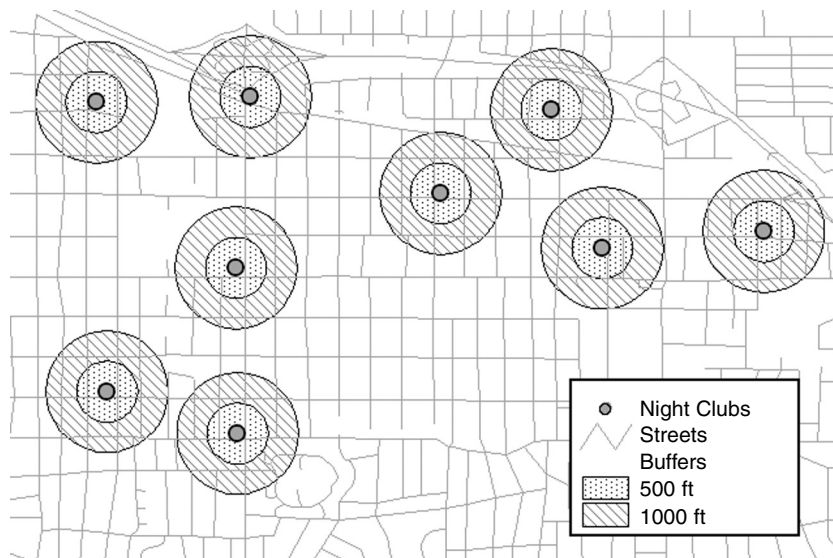


Figure 4.7 Buffer Map Example: Two Buffers

Figure 4.8 is a map in which points are graduated by size according to the numbers of crimes at specific locations.

In a graduated color map, the colors of the symbols reflect their values; this kind of mapping can be used with points (in a single-symbol map only),² lines, and polygons. Figure 4.9 is a map that uses colors to show the total numbers of crimes in particular areas—the lighter shaded areas are those with fewer crimes, and the darker shaded areas are those with more crimes.

Chart Mapping

Chart mapping allows the crime analyst to display several values within a particular variable at the same time (e.g., variable = crime, values = robbery, assault, and rape). There are two types of chart mapping: pie and bar. In **pie chart mapping**, the relative percentages (represented by slices of a pie) of values within a variable are displayed. Figure 4.10 is an example of a pie chart map that depicts fights, drugs, weapons, and disorderly conduct incidents at nightclubs. The pies are placed at the locations of all the nightclubs in the area mapped, and the sizes of the pies are graduated to depict the total occupancy capacities of the nightclubs, which provides a relative comparison. Some of the nightclubs represented have had all four types of incidents, whereas others have had only two or three of the four, and the percentages (slices) are based only on the frequencies of the values included (not all types of incidents at all nightclubs).

In **bar chart mapping**, the relative frequencies (represented by bars) of values within variables are displayed. In the example in Figure 4.11, bar charts are placed at the locations of the nightclubs in the area mapped. This figure depicts the same



Figure 4.8 Graduated Size Map Example



Figure 4.9 Graduated Color Map Example

data shown in Figure 4.10, but instead of percentages, the heights of the bars show the frequencies of incidents.

Density Mapping

In **density mapping**, analysts use point data to shade surfaces that are not limited to area boundaries (as is the case in graduated color mapping). In their most

46 INTRODUCTION

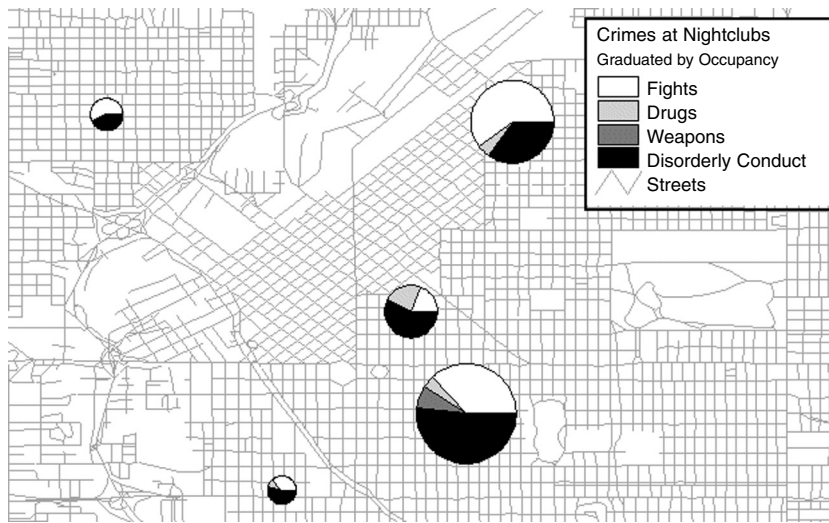


Figure 4.10 Pie Chart Map Example

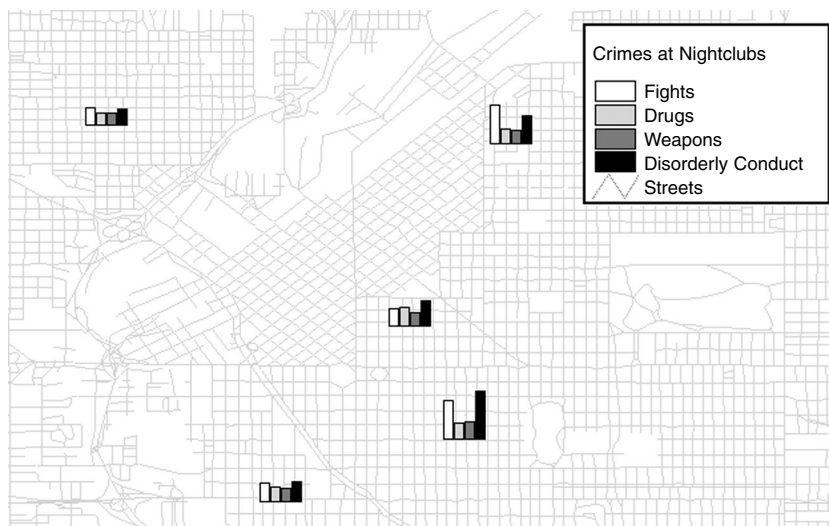


Figure 4.11 Bar Chart Map Example

basic form, density maps are shaded according to the concentration of incidents in particular areas. In the map shown in Figure 4.12, the darker colors represent areas in which the incidents are more concentrated, and the lighter colors represent those in which the incidents are less concentrated. Such maps are used to compare small variations in crime levels from one area to another rather than to compare levels of crime within fixed artificial geographic boundaries, as in area maps. (For more detailed explanation of density mapping, see Chapter 12.)



Figure 4.12 Density Map Example

Interactive Crime Mapping

Rather than a type of mapping, the term **interactive crime mapping** refers to simplified geographic information systems made available to novice users over the Internet. Many police departments have interactive Web sites where citizens and police officers can conduct basic crime mapping themselves. These applications typically are not flexible or sophisticated enough to be useful to crime analysts. To illustrate interactive crime mapping, Figures 4.13 and 4.14 depict selected screens found on the East Valley COMPASS (Community Mapping, Planning and Analysis for Safety Strategies) interactive Web site, which is hosted by the Redlands, California, Police Department (<http://www.eastvalleycompass.org>). Figure 4.13 shows the query screen of this site's mapping program, which allows the user to choose a particular type of data. In other queries, the user can request data for particular locations, areas of interest, or time frames. Figure 4.14 shows the single-symbol map resulting from a query, with its legend on the right-hand side and different types of functions (e.g., zoom, pan, identify) listed on the left. The user can manipulate the map with limited functions, query different data, and print maps and reports.

History of Crime Mapping

Even though crime mapping plays a significant role in crime analysis today, conducting spatial analysis and creating crime maps have only recently become common in policing and crime analysis, thanks to advancements in technology. Unlike crime analysis, the history of crime mapping begins not with the establishment of the first police force, but with researchers long before computers were invented.

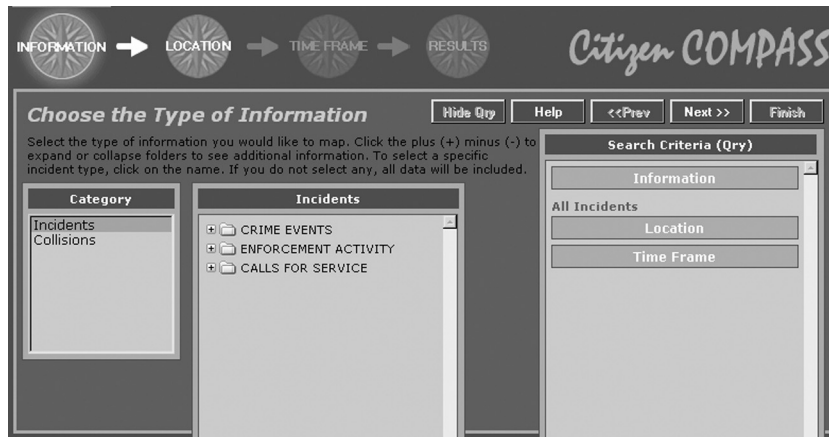


Figure 4.13 Interactive Map Example: Query Screen



Figure 4.14 Interactive Map Example: Resulting Map

Beginnings of Crime Mapping

In the 1800s, European researchers who adhered to the school of thought known as the cartographic school of criminology examined the levels of crime within different areas (regions) and the relationship of these levels to sociological factors, such as socioeconomic status (Groff & La Vigne, 2002). For example, in 1829, Adriano Balbi, an ethnographer and geographer, and André-Michel Guerry, a lawyer, created the first maps of crime using criminal statistics for the years 1825 to 1827 and demographic data from the census. They examined crimes against property, crimes against persons, and levels of education in France and found that areas with high levels of crimes against property had a low incidence of crimes

against people and that higher numbers of educated people lived in areas with more property crime (Weisburd & McEwen, 1997). Also during this period, the Belgian astronomer and statistician Quêtelet used maps to examine correlations between crime and transportation routes, education levels, and ethnic and cultural variations (Weisburd & McEwen, 1997).

United States: 1900–1970

In the United States, the use of crime mapping began a little later than it did in Europe. Because the United States was a relatively new country in the 1800s, reliable maps were not readily available and census data were not regularly collected, as they were in France and England at that time. The first substantive spatial analysis of crime in the United States was conducted in the 1920s and 1930s by urban sociologists in Chicago. Their crime research and related crime maps linked crime and delinquency to factors such as social disorganization and poverty. In fact, these scholars' spatial analysis of juvenile delinquency and social conditions in Chicago is considered to be one of the foremost examples of crime mapping in the first half of the 20th century (Groff & La Vigne, 2002).

Crime mapping was a theoretical component in the development of the concentric zone model, which contends that in an urban setting different types of zones (areas with different purposes) form around a central business district and that some of these zones are more prone to crime and disorder than are others. Researchers who analyzed the locations and distribution of gangs in Chicago based on the concentric zone concept found that gangs were concentrated in parts of the city where social control was weak and social disorganization was high (Weisburd & McEwen, 1997). Most of the early crime mapping conducted in both Europe and the United States examined aggregate levels of crime by area. However, evidence exists of a map that was created by hand in 1929 by Chicago school researchers in which the home addresses of more than 9,000 delinquents were clustered in particular areas of Chicago (Weisburd & McEwen, 1997).

Through the 1950s, 1960s, and 1970s, sociologists and others who were interested in crime and its causes continued to examine the sociological factors associated with crime. The explanations and geographic methods of analysis used remained fairly uncomplicated during this period, possibly owing to the researchers' focus on sociological factors and the lack of adequate technology (Groff & La Vigne, 2002). In the late 1960s, scholars began conducting spatial analysis of crime with the help of large computer systems and unsophisticated visualization methods (Weisburd & McEwen, 1997).

1970 to Present

From the late 1960s through the early 1980s, a group of researchers in England, Canada, and the United States shifted their focus of the study of crime away from what traditional criminology examined—criminal offender—and toward the criminal event and its context, including the physical and social environments that create opportunities for crime (Brantingham & Brantingham, 1981; Clarke,

50 INTRODUCTION

1980, 1983; Cornish & Clarke, 1986). This movement affected crime mapping, as researchers shifted from aggregate analysis of crime and social factors to the analysis of discrete criminal events and their locations (for a more detailed discussion of this theoretical approach, see Chapter 5). Consequently, researchers began to incorporate information about geography and environment into their study of crime problems and related issues, such as rape (LeBeau, 1987) and a host of other crimes (Harries, 1980) as well as distribution of police personnel (Rengert & Wasilchick, 1985).

In the early 1980s, client server technology made geographic information systems more available, and this enabled a number of police departments to experiment with crime mapping in their everyday work (Groff & La Vigne, 2002). A project funded by the National Institute of Justice partnered researchers and practitioners in five U.S. cities to use innovative analytic techniques in studying drug markets and tracking their movements over time (Groff & La Vigne, 2002):

- In New Jersey, Rutgers University and the Jersey City Police Department implemented an experimental design to test problem-oriented policing responses to reduce violent crime.
- In Connecticut, the city of Hartford joined with Abt Associates, a private consulting firm based in Boston, to promote crime mapping as a way of encouraging community involvement in addressing crime problems.
- In California, the San Diego Police Department and the Police Executive Research Forum mapped drug incidents and drug markets with police interventions in an experiment that evolved into a crime mapping system.
- In Pennsylvania, Carnegie Mellon University and the Pittsburgh Bureau of Police developed a system in which thematic maps were created to show changes in crime by area over time.
- In Missouri, the Kansas City Police Department partnered with the Crime Control Institute to develop an innovative narcotics enforcement strategy aimed at reducing the violence and disorder associated with retail drug sales in residential neighborhoods.

These projects led the way for crime mapping partnerships between practitioners and researchers and demonstrated how communities could use GIS tools as a central part of crime control initiatives. The program was focused primarily on the use of geographic police data, but the participants found that examining other geographically based data contributed to their ability to target problem-solving strategies, brought together key partners with different perspectives, and facilitated the assessment of their joint efforts (Taxman & McEwen, 1997).

In the early to mid-1990s, significant improvements in computer technology and police data systems made electronic crime mapping a much more practical tool for police and researchers. GIS software became available for desktop computers as these computers became capable of processing large amounts of data quickly. In addition, police data on crimes, arrests, accidents, and calls for service became available electronically through computer-aided dispatch systems as well as through electronic records management systems (for discussion of these innovations, see Chapter 7).

Geographic data such as street and census information became widely available in electronic format and were provided free or at minimal cost by a variety of government agencies and commercial organizations. All of these developments helped to advance the field of crime mapping beyond manual methods and the use of large, costly mainframe mapping systems.

In 1993, the Illinois Criminal Justice Information Authority and the Sociology Department of Loyola University of Chicago joined forces to present a computer crime mapping workshop in Chicago. In a publication resulting from the workshop titled *Crime Analysis Through Computer Mapping* (Block, Dabdoub, & Fregly, 1995), participants—many of whom are top researchers and analysts in the field today—described spatial analytic techniques and offered practical advice for both police professionals interested in implementing computer mapping in their agencies and students of spatial analysis. This workshop was one of the first efforts to bring practitioners and researchers together to discuss crime mapping.

During the mid-1990s, the federal government, in a movement spearheaded by Vice President Al Gore, provided increased support for crime mapping technology and methods. Police agencies received federal funding to obtain crime mapping technology, and several programs were developed specifically to assist police agencies with the implementation of crime mapping. The U.S. Department of Justice's Office of Community Oriented Policing Services (the COPS Office) allocated a significant amount of funding for crime mapping software and equipment through a program called MORE (Making Officer Redeployment Effective). The primary objective of this funding was to "expand the amount of time current law enforcement officers can spend on community policing by funding technology, equipment, and support staff" (Office of Community Oriented Policing Services, 2004). Table 4.1 displays the details of the MORE funding, including how much of the money was allocated directly to crime mapping technology and staff. As the table shows, in a period of only 7 years the COPS Office provided more than \$53 million to police agencies specifically for crime mapping.

Since 1995, the COPS Making Officer Redeployment Effective (MORE) program has provided funds in excess of 1.3 billion dollars to law enforcement agencies for the purchase of time-saving technology and civilian personnel. The time savings produced by these grants has resulted in the redeployment of officers to the street in order to enhance their community policing efforts. Some of the funds provided by MORE grants have been used to purchase crime mapping and GIS hardware and software. The COPS Office recognizes the important role that crime mapping plays in the in-depth analysis of community problems. This increased analytic capability improves the capacity of law enforcement to work with the community to develop more effective solutions to crime and social disorder problems.

—Dr. Matthew Scheider, social science analyst, COPS Office
(personal communication, October 8, 2003)

52 INTRODUCTION

Table 4.1 Federal Funding for Crime Mapping

<i>Year of Grants</i>	<i>Total Number of Grants</i>	<i>Total Funding (\$)</i>	<i>Number of Grants for Mapping</i>	<i>Funding for Mapping (\$)</i>
1995	912	130,323,886	9	5,840,333
1996	1,050	187,426,110	25	6,439,829
1998	1,457	383,258,265	44	37,890,292
2001	536	78,554,321	6	1,623,859
2002	294	61,442,799	6	1,296,527
Total	4,249	841,005,381	90	53,090,840

SOURCE: Matthew Scheider, social science analyst, Office of Community Oriented Policing Services (personal communication, October 6, 2003).

To accompany the MORE funding, the COPS Office, in partnership with the Police Foundation, created the Crime Mapping Laboratory in 1997 to assist the policing community in integrating crime analysis and crime mapping into community policing and problem solving. Over the years, the lab has provided a wide range of training opportunities and technical assistance to the policing community and has published numerous reports and resource documents (updated yearly) on topics related to crime analysis, mapping, and problem solving. Its most recognized product is the newsletter *Crime Mapping News* ("Police Foundation Crime Mapping Laboratory," 2003, p. 1)

The Crime Mapping Research Center, now called the Mapping and Analysis for Public Safety (MAPS) program, was formed within the Department of Justice's National Institute of Justice in 1997 with the goal "to promote research, evaluation, development, and dissemination of GIS technology for criminal justice research and practice." The program provides "many beneficial services such as grant funding, annual conferences, information on training centers, publications, research, and more" (Mapping and Analysis for Public Safety, 2004).

Since its creation, the MAPS program has held annual conferences at which practitioners and researchers come together to discuss research and spatial analytic techniques. The program has also conducted a national survey of crime mapping, funded fellowships, developed training curricula, and published books on crime mapping. With the program's help, the United States has seen interest in and development of crime mapping and crime analysis techniques increase significantly among police departments and researchers.

In 1998, the National Institute of Justice created the Crime Mapping and Analysis Program (CMAP), the mission of which is "to provide technical assistance and introductory and advanced training to local and state agencies in the areas of crime and intelligence analysis and geographic information systems (GIS). GIS includes

crime mapping, global positioning systems, automatic vehicle locator systems, and the use of this technology for the electronic home monitoring of community corrections clientele” (Crime Mapping and Analysis Program, 2004). CMAP has provided training to a significant number of crime analysts and officers in the field. In 2001, CMAP held a symposium on crime mapping topics that resulted in a publication titled *Advanced Crime Mapping Topics* (Bair, Boba, Fritz, Helms, & Hick, 2002), a collaborative document written by the attendees that includes articles on the role of crime mapping in crime series or investigative analysis, in operations research or resource allocation studies, in problem solving or applied research, and in discrete site analysis.

Another relatively recent influence on the use of crime mapping in policing is Compstat, a data- and mapping-driven police management strategy created by the New York City Police Department and adopted by other police agencies across the United States. A core component of Compstat is police officials’ use of crime mapping software and analysis in weekly meetings to understand local patterns of crime and disorder incidents. Crime mapping is such an integral part of the Compstat program that during the 2001 television season, CBS’s *The District*, a show based on New York’s Compstat experience, highlighted crime mapping in every episode (Theodore, 2001).

To date, no historical study has been conducted on the adoption of crime mapping by police agencies, but David Weisburd, a distinguished professor in the field of crime and place, recently examined the rate of adoption of crime mapping in the 1990s through a number of surveys and a pilot study of his own and found that “crime mapping has become widely diffused among police agencies, that the diffusion process began in the late 1980s–early 1990s and gained momentum in the mid 1990s, and that the adoption of crime mapping appears to follow the standards curve of diffusion of innovation” (Weisburd & Lum, 2001, p. 7).

Current State of Crime Mapping

In 1997, the MAPS program conducted a nationwide survey to gauge the use of GIS technology for crime mapping throughout the police community. The researchers found that 13% of the 2,004 police departments responding to the survey reported using computerized crime mapping. It is interesting to note that 36% of larger departments (those with more than 100 officers) reported using computerized crime mapping, whereas only 3% of smaller departments (those with fewer than 100 officers) did so; this variation in the adoption of GIS technology by agency size is an important finding.

The MAPS survey also revealed that departments that were using crime mapping also geocoded data, mapped calls for service as well as various types of crime data, and primarily created single-symbol or graduated size and color maps. Most of the responding departments that were conducting crime mapping reported using visual analysis to identify hot spots and clusters of activity, and about one-fourth used statistical methods to do so. In addition, a majority of these departments reported maintaining several years of data for mapping purposes, which

54 INTRODUCTION

suggests that they may also conduct long-term (strategic) crime analysis (Mamalian & La Vigne, 1999).

The survey also showed that police departments were using mapping to visualize crime incident locations for officers and investigators, to make resource allocation (staffing) decisions, to evaluate interventions, to inform citizens about crime in their neighborhoods, and to identify repeat calls for service and crime locations. Factors that appeared to inhibit departments' implementation of crime mapping included limited financial resources, limited time, and lack of training (Mamalian & La Vigne, 1999).

No national studies of crime mapping have been conducted in recent years, but it seems safe to assume that the rate of adoption of crime mapping has slowed significantly in the United States for two major reasons. First, many, if not most, police agencies with more than 100 officers already have crime mapping technology in place, either for analysts or for officers. Smaller departments that do not yet have the technology may never adopt it, for financial and personnel (availability and training) reasons. Second, the focus of federal funding for law enforcement has shifted to homeland security since the terrorist attacks on New York City and Washington, D.C., of September 11, 2001. Although mapping plays a significant role in helping law enforcement prepare for and respond to acts of terrorism, local police departments are only one partner in this process and are likely to focus their mapping efforts on operational needs rather than terrorism concerns.

Another interesting element in the development of crime mapping is that in the past decade both crime analysis and crime mapping have evolved, but they have done so along different paths. This is evidenced by the differences in their histories (i.e., academic vs. police beginnings) and by the fact that, of the two, crime mapping has received greater funding, inspired the establishment of more organizations, and been the subject of more publications.

Crime Mapping as a Career Track

Even though many crime analysts utilize crime mapping in their daily work, many police agencies have established specific positions that are filled by people who specialize in spatial analysis of crime. These individuals, who are often called GIS analysts, are considered to be different from crime analysts. Salaries for GIS analysts are typically higher than those for crime analysts because of the specialized technical skills required and because police agencies must compete for qualified analysts with private companies offering high salaries. Compared with crime analyst positions, significantly fewer GIS analyst positions are available, for a number of reasons: (a) Smaller departments that conduct crime analysis typically have only one crime analyst position, and that is not a specialist position; (b) many police officials do not feel that filling a position with a person who works only on spatial analysis of crime is warranted; and (c) the number of potential applicants for GIS analyst positions (i.e., individuals who have both geography and criminal justice backgrounds) is relatively small.

Individuals with expertise in spatial analysis of crime may also find careers in organizations other than police agencies. The position of geographic profiler is one example; this kind of analyst is an expert in predicting the probable locations of criminals' residences based on the locations associated with their crimes (Rossmo, 2000). This position, which requires a full year of training, exists primarily in federal agencies (e.g., the Bureau of Alcohol, Tobacco, and Firearms and the FBI) rather than local ones, because many geographic profiles are based on crime series that cross jurisdictions. Positions are also available in government and non-profit agencies that seek to work with police agencies through research or technical assistance (e.g., MAPS, CMAP, the Police Foundation, Abt Associates, the Institute for Law and Justice, and the Urban Institute). Police officers are also now receiving training in mapping, so the position of trainer of GIS for policing is becoming more common. Finally, individuals with advanced skills in policing and computer programming can work for private software companies that develop mapping software for police departments and crime analysts.

For undergraduate college students who are preparing for careers in the spatial analysis of crime, classes in geographic information systems and criminal justice are appropriate. Currently, no U.S. university offers a graduate program specifically in crime mapping, but many universities offer GIS certificates for majors in criminology who want to hone their spatial analysis skills.

Summary Points

This chapter has provided an overview of geographic information systems and crime mapping, describing the geographic features used in mapping and the various types of mapping, the history and current state of crime mapping, and crime mapping as a careers. The following are the key points addressed in this chapter:

- A geographic information system is a set of computer-based tools that allows the user to modify, visualize, query, and analyze geographic and tabular data.
- Crime mapping is the process of using a geographic information system to conduct spatial analysis of crime problems and other police-related issues.
- The three main functions of crime mapping are (a) to facilitate visual and statistical analyses of the spatial nature of crime and other types of events, (b) to enable analysts to link unlike data sources together based on common geographic variables, and (c) to provide maps that help to communicate analysis results.
- A GIS uses four types of geographic features to approximate real-world elements: points, lines, polygons, and images.
- In single-symbol maps, individual uniform symbols represent features.
- Buffers are areas that represent specified proximate zones around features on a map.
- In graduated maps, the sizes or colors of features represent the values of the variables.

56 INTRODUCTION

- Chart maps, which can use either pie or bar charts, allow the illustration of several values within a particular variable.
- In density maps, areas without boundaries are shaded according to the concentration of incidents within them.
- The term *interactive crime mapping* does not refer to a type of mapping; rather, it refers to simplified geographic information systems made available to novice users over the Internet.
- The beginnings of crime mapping are different from the beginnings of crime analysis in that crime mapping began through the work of researchers (vs. police) in the 1800s and the early 1900s.
- The first substantive spatial analysis of crime in the United States was conducted in the 1920s and 1930s by urban sociologists in Chicago. This research focused on linking crime and delinquency to factors such as social disorganization and poverty.
- In the 1970s and 1980s, improvements in technology and academic developments encouraged the use of crime mapping in police agencies. However, the use of crime mapping did not increase dramatically until the 1990s.
- Federal funding in the form of grants and the establishment of crime mapping centers, improvements in technology and data collection, and the implementation of Compstat in police agencies across the United States fueled the rapid adoption of crime mapping in the mid- to late 1990s.
- Currently, most large police agencies use some form of crime mapping for one or more of the following purposes: to provide officers and investigators with information on crime incident locations, to make resource allocation (staffing) decisions, to evaluate interventions, to inform citizens about crime in their neighborhoods, and to identify repeat calls for service and crime locations.
- Crime mapping positions in police departments are sometimes separate from crime analysis positions and in many cases have higher salaries because of the high level of training and expertise required. Crime mapping positions are much rarer than general crime analysis positions.

Exercises

Exercise 4.1

Using the Internet, a newspaper, a magazine, or your local police department as your source, obtain an example of a map that displays crime information. List the following information about the map:

- Type of map (e.g., single symbol, graduated by size)
- Geographic area represented in the map (e.g., city, state, neighborhood)
- Data on the map (e.g., crime, population, accidents)
- Time period of the data (i.e., list dates)
- Creator of the map (e.g., agency and individual, if shown)

Discuss the following about the map:

1. What seems to be the purpose of the map?
2. Does the map seem to serve its purpose?
3. Is the map informative and helpful?
4. Does the map make sense?

Exercise 4.2

To review the specific concepts associated with geographic information systems, go online and complete Lesson 1 of the “Free Module: Learning ArcGIS 8.” (This module includes conceptual material as well as exercises; it is not necessary to load the software and do the exercises.) Follow these directions to complete the lesson:

- Go to <http://campus.esri.com>. If you are already a Virtual Campus member, sign in with your member log-in and password. If you are not a member, click “Join now” under “Member Sign-In” and complete the form to become a member.
- Click on “Free Training” on the left-hand side of the page.
- Go to the 13th course, called “Learning ArcGIS 8, Part I.”
- Look for the “Free Module” in the upper right-hand corner and click on “Enroll Today.”
- Click on “Basics of ArcGIS.”
- Click on “Lesson 1: Introducing GIS.”
- Go to the bottom of the screen and read the section headed “Before you start” before starting.
- Follow the rest of the directions to complete the course. (*Note:* For this exercise, do only Lesson 1.)

Notes

1. The maps presented in this chapter are not “final” maps—that is, they are not complete maps that would be suitable for distribution to particular audiences. Rather, these maps are intended only to illustrate particular types of maps or techniques.
2. Both graduated color and graduated size cannot be displayed using the same points on a map. For example, if two robberies occurred at one location, the point for that location would be larger in size than points where only single robberies occurred. One cannot then shade that point to show that two different types of weapons were used in the robberies (one a gun and the other a knife).

