MAPPING CRIME FOR ANALYTIC PURPOSES: LOCATION QUOTIENTS, COUNTS, AND RATES

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Abstract: *Crime can be analyzed and mapped in a number of different ways. This article compares maps of violent crime across the cities of British Columbia utilizing three crime measures: counts, rates and crime location quotients (LQCs). The LQC, adapted from regional planning, provides views of crime patterns not obtained with the two more traditional measures of crime. When used in conjunction with crime counts and rates, the LQC offers a way of understanding how one area is different from another for purposes of research and deployment of prevention and control resources.*

Crime and its contextual backcloth exist at many spatial and temporal levels of resolution, from the international scene to the individual crime site, from the trends of centuries to the patterns of seconds (Brantingham and Brantingham, 1993, 1984; Brantingham et al.,

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1976). That is, crime can be studied, analyzed and dealt with at many different levels of aggregation in time and space. Meaningful crime analysis can be done, for instance, at international levels, at national levels, across smaller areas that range from regions to states to counties to cities, and at detailed levels within a particular city — even down to the street block or individual address level. Temporal analyses can sweep across centuries, can examine a set of years, months, days, hours, minutes or seconds. Over the past decade, mapping has become a key tool for crime analysts seeking to understand the patterns of crime (see, e.g., Block et al., 1995), enabling them to see or visualize differences and similarities across time and space.

Analyses of individual criminal events and of individual person, building or street victimization studies are currently of great interest (Clarke, 1980, 1992), but for practical purposes individual criminal events must be aggregated in order to assess patterns and devise methods for addressing them (e.g., Kohfeld and Sprague, 1990; Kennedy and Forde, 1990; Normandeau, 1987; Brantingham et al., 1991; Cusson, 1983, 1993). The variety of questions open to the crime analyst and the level in the cone of resolution used in analysis will always vary with the type of problem being considered. In addition, the type of crime measure used in analysis will vary with the problem under consideration.

This article explores how questions about crime, measures of crime and levels of resolution are linked conceptually, and how crime analysis can be improved by mapping different measures of crime and comparing the results. The article illustrates this by mapping three different crime measures — the crime count, the crime rate, and the crime location quotient (LQC) — at the interurban level of resolution, utilizing 1994 crime data from the 68 separate municipal policing jurisdictions in British Columbia, CAN.[1]

A particular emphasis is placed on crime location quotients because this is a relatively new technique for criminologists. The LQC will be described in more detail later in this article, but it is basically a method of measuring the relative mix of different types of crimes for a particular area compared to the mix in surrounding areas. For example, a city such as Tucson or Virginia Beach can have a relatively low robbery rate but still have neighborhoods in which robbery makes up a relatively high proportion of all crimes compared to the city as a whole. Robbery is a problem in such neighborhoods even when it is not a problem citywide. Conversely, robbery can make up a very high proportion of offenses in a city such as San Francisco or

Newark, but within such "robbery* cities there will be subareas in which robbery represents a low proportion of crimes. Such proportional mixes are independent of total crimes in an area, and really represent a local crime "specialization."

As will be shown in this article, when used in conjunction with crime counts and crime rates, LQCs offer a way of understanding how one area is different from another for purposes of research and deployment of prevention and control resources. This article focuses on city-level data, but the LQC can be used for comparison of states or nations on the one hand or for comparison of regions, cities or neighborhoods on the other. The LQC can be used for comparison of the crime mix in different decades within centuries in historical research, or for comparison of the crime mix within the different hours of the day in thinking about deployment of police during different shifts. It is a tool that can be used at different levels of spatial and temporal resolution.

STATISTICAL CRIME ANALYSIS

There is a need for constant improvement and innovation in methods of analysis, no matter what questions are being asked or what levels of resolution are being studied. Methods are constantly changing. The methods used by criminologists frequently originate from other disciplines such as sociology, psychology, geography, statistics or mathematics. These are not static disciplines. Interestingly, many currently used techniques had their origins in studies of criminal events. For instance, in statistics both Quetelet (1842) and Poisson (1837) focused on the study of crime. Galton, Pearson and Yule were all concerned, among other things, with developing statistical techniques that could be used to understand crime, as both hereditary and social problems (Stigler, 1986).

This article describes and maps the LQC, a new type of crime measure borrowed from the related disciplines of regional economics and regional planning. The location quotient (LQ) is used in regional planning and regional economics to look at *relative* local economic activity. LQs will be described in some detail after a brief review of crime counts and crime rates.

Crime analysis in the tradition of Guerry (1831) and Quetelet (1842), and as conducted by most criminologists, looks at crime as an aggregate measure for some summary unit. The most common summary measures are crime counts and crime rates based on po-

lice-recorded offenses, victimization rates based on survey estimates, and offender rates based on surveys and judicial convictions data.

Crime counts are used to assess the locations of "hot spots," assess police work loads and estimate future resource needs. Police, after all, must respond to discrete events, not estimates or ratios. In Canada, crime counts take the form of "actual crimes." These represent events recorded as crimes following a preliminary investigation that has established that a "reported crime" has in fact occurred. Crime rates, in contrast, are used to assess the risk of crimes occurring to particular types of people in particular locations or at particular times, and to assess trends discounted for changing conditions (such as population growth). Crime rates are particularly useful in planning prevention campaigns and in assessing the impact of changing social conditions of the risk of crime. Crime rates use some measure of crime occurrence as a numerator and units at risk as a denominator. The numbers in the numerator and denominator vary. Ideally the numerator is some measure of events or occurrences, and the denominator is the most direct measure of units at risk. When the numerator is a personal crime, the denominator frequently is the number of people residing in the aggregation area. When the numerator is residential breaking and entering, the denominator frequently is the number of dwelling units.

There are always problems with such crime measures. The count of events, based on official data, is usually an undercount both because some crimes are not reported to police and because counting and recording rules typically record only the most serious offense in any complex criminal transaction. Such counts do, however, appear to be good measures of serious offenses and of offenses involving lost property covered by insurance (Litton and Pease, 1984; Brantingham and Brantingham, 1984; Gove et al., 1985). There are difficulties obtaining reasonable estimates for denominators when the potential "victims" move or are moveable. Boggs' (1960) work began the exploration of how patterns change as the denominator in the ratio changes. For example, an auto theft rate based on a residential population ratio produces a very different picture of high- and low-crime areas in a city from that produced by a rate calculated using the number of automobiles present in the different areas. Boggs' (1960) work has been carried many steps further by Harries (1991); both show the interesting variability in what is "seen" as denominators change.

LOCATION QUOTIENTS

Location Quotients (LQs) are a measure developed in regional planning and economics to try to address questions of the relative structure and importance of local economies, while conceptually avoiding some of the stationarity problems of spatial analysis. Local areas are placed within a wider comparative context for analysis. Regional science has always looked for ways to compare activity at metropolitan or regional levels of aggregation.

LQs were developed to indicate activity in one area compared to its surrounds. For example, within a metropolitan area the city center will contain most of the commercial activities. Rural farming areas also have commercial centers: some small towns provide minimum essential goods and services; slightly larger towns provide a larger array of goods and services for a wider area encompassing a number of the smaller towns and their hinterlands; while finally a major city will provide a much wider range of specialized goods and services to a much larger region encompassing many hinterlands, small towns, and larger towns. Each town, however, is a commercial center, although the volumes of business in the smaller towns make it difficult to see them as commercial centers from the perspective of large cities. Still, the small town commercial centers may provide the same core mix of commercial activities (albeit with less choice of suppliers) provided in the largest cities. When the smaller towns and large cities provide the same mix of goods and services, they may be functionally equivalent even though their volumes of activities are very different. Rural towns attract business from the hinterland; large cities attract business from the hinterland and from the rural towns.

Similar considerations can be seen at work across the neighborhoods and communities within large cities. Bedroom neighborhoods often have small local commercial and entertainment districts; larger subdivisions have local shopping malls, bar clusters, multi-screen theaters; and finally, the urban center has a dense business, entertainment and industrial concentration that attracts people from all parts of the metropolis. Commuting between areas is the modern urban way of life.

Before this article describes the way LQs are calculated, it should start to become clear that such relative measures have a use in crime analysis. Within a country such as the U.S. certain states and cities dominate the total counts of crimes or have the highest crime rates. However, even in lower crime states or cities, there can be certain types of crimes that are disproportionally present compared to their surrounding areas and disproportional compared to the mix in

higher-crime-rate cities or states. For example, 40 or 50 robberies in a city in a low-robbery state such as Idaho or Wisconsin may make that a relatively high-robbery city in context. In contrast, a city with 40 or 50 robberies in a high-robbery state such as California would be a relatively low-robbery city. This type of relative specialization can have meaning in crime analysis, particularly when the analysis is related back to the relative mix of other socio-economic conditions.

From the planning perspective, the primary purpose of analysis is often to make predictions about future activity, and to base those predictions on the way the area under study functions in relation to its surrounding area. What happens in one city is seen to depend not only on what happens in other cities but also on what happens or what exists in surrounding resources. For example, what happens in Vancouver or New York or Madrid depends on what happens in other large cities, but also on what happens in the local areas surrounding them. The interrelationship between and within urban areas, and between urban and rural areas, is complex. Relationships can be explored within any particular urban area as well as between urban areas. What happens in one neighborhood can be compared to what happens in surrounding neighborhoods.

Equation 1 presents the basic formula for a Location Quotient in Regional Science (Klosterman et al., 1993). While many economic activity indicators might be used, LQs are frequently calculated on the basis of employment. Employment can be defined in many ways, but is frequently divided into service, manufacturing, secondary and primary extraction groups. Each of these may be subdivided repeatedly, working down to detailed types of employment.

$$(1)\ LQ_{i_n} = \frac{E_{i_n}}{E_{t_n}} \Bigg/ \frac{\sum_{n=1}^{N} E_{i_n}}{\sum_{n=1}^{N} E_{t_n}}$$

Where:

n = small area under study

N = total number of areas

E_i = employment in industry i

E_t = total employment in all industries

The LQ assumes a "normal" distribution in a "standard" area, that is, a "normal" number of jobs in a certain category in a "standard" area. Within regional sciences this normal number is used as a measure of the amount needed to satisfy regional demand (self-sustainability). When the local amount falls below the normal

amount, it is assumed that goods (or services) are exported. Equation (1) shows the ratio for importing or exporting. The numerator counts the number of persons employed in a particular type of job in a specific area divided by the total employed in that area. The denominator is a similar ratio for a comparison surrounding area that may be used as the "normal" distribution for the "standard" area. The equation can be formulated for different study areas and different categories of employment, and can involve comparison with different standard areas. While there are obvious problems with this measure in regional science, it does provide the potential for a relative crime measure in criminological studies.[2]

USE OP LOCATION QUOTIENTS IN CRIMINOLOGY

In criminology, of course, Location Quotients would use crimes as the basic unit of count. Equation (2) restates the Location Quotient formula in criminological form:

(2)

$$LQC_{i_n} = \frac{C_{i_n}}{C_{t_n}} \Bigg/ \frac{\sum_{n=1}^{N} C_{i_n}}{\sum_{n=1}^{N} C_{t_n}}$$

Where:

n = small area under study

N = total number of areas

C_i = count of crime i

C_t = total count of all crimes

Using an LQC, some towns and cities would be identified as centers for violent crimes; others, as centers for property crimes. Some are centers for robbery; some for burglary; some for automobile theft. The center in one region might not appear to be a center when compared to centers in other regions. This is similar to a small town being a center of commerce in a rural area but not in a large urban area. It is perhaps more important to note that, since this is a relative measure, a center cannot have high LQs for all crimes. It is a measure that identifies relative area specialty in crimes.

The advantage of an LQC in crime analysis is that there is no need to obtain a count of the number of targets as is necessary in calculating a crime rate. The LQC for robbery would be based on counts of robberies and all crimes,[3] not population or number of target businesses. The LQC for motor vehicle theft would be based on vehicle

thefts and total crimes, not the number of people or the number of motor vehicles. In this way, the LQC minimizes the problems highlighted by Boggs (1960) and Harries (1991) in their discussions of which types of denominator variables to use in constructing rates for different types of crimes. Stationarity is still a problem, but can be addressed by recalculations for different time periods.

Table 1 provides a hypothetical example of how LQCs work. In this example there are five states listed (States A to E) as well as a national total for all index offenses and for robbery. As can be seen in the table, robbery makes up 5% of index offenses nationally. State A has a low number of robberies but has the same robbery rate as State B, which has the highest number of robberies and the highest robbery rate. State A has an LQC greater than State B. This means that while these two states have the same robbery rates, State A has a higher proportion of robbery offenses compared to the national proportion than does State B. They are both high rate states, but State A shows a "preference" for robbery compared to State B. Robbery is a larger part of the total crime problem in State A than in State B. State C has the same high robbery rate as State A and State B, but it has a much lower total crime rate than would be expected from the national trend. Consequently, State C has a LQC 7 times what would be expected from the national trend. State D and E both exhibit low robbery rates but have LQCs similar to State A. Although robbery rates are low, they make up a relatively large share of the crime problem in both States D and E. The point is that LQCs do not necessarily "copy* crime rates or crime counts. They are really a dimensionless measure of preference or choice of crime type in the smaller unit compared to a larger trend.

Table 1: Location Quotient Example: Hypothetical States

State	Robbery Count	Total Crime Count	Population	Robbery Rate	Robbery LQC
State A	10,000	150,000	25,000	400	1.4
State B	50,000	1,500,000	12,500,000	400	0.7
State C	25,000	75,000	6,250,000	400	7.1
State D	25,000	375,000	13,000,000	192	1.4
State E	3,000	40,000	1,500,000	200	1.6
USA Total	660,000	14,000,000	258,000,000	256	0.05

The LQC provides an additional, alternative view of crime. It is not a rate and is not a percentage. The LQC is without dimension; it is a relative measure. When a study area (be it a state, a city or a neighborhood) has an LQC equal to 1.00 for a specific crime, that means that it has a proportional mix of that crime similar to the larger comparison area (country, state or city). When the value of the LQC falls below 1.00, the relative proportion of that crime in the smaller study area is below the normal trend in the larger comparison area. When the LQC is above 1.00, the specific crime is above the normal trend. In fact, the amount above 1.00 indicates the percentage above the normal trend. In Table 1, State A has an LQC value of 1.4, meaning that it is 40% higher than the national trend for robbery. State B has an LQC value of 0.7, or is 30% below the national trend. State C has an LQC of 7.1, or is 610 % above the national trend! Robbery is the major crime problem in State C. States D and E both have low robbery rates, but robbery is a relatively greater problem in the latter than in the former.

Statistical models using LQCs are different from the models most commonly constructed by criminologists. LQCs are relative measures and are potentially helpful when analyzing fear or concern about crime. A widespread fear of murder by a stranger can be triggered in a small community by one local crime, while a similar level of fear might require clear evidence that a serial killer is active before being triggered in a large urban center. Similarly, one or two bank robberies might seem like very little in New York City, but a large number in smaller towns like Flemington or Montauk. LQCs may also prove good predictors of local media response to specific reported crimes or even to variations in sentences in different places at different times.

LQCs are also indicators of what attracts people, both locally and from a distance, to a particular location. Some crime sites are crime generators; others are crime attractors. Crime generators are places that attract large volumes of people, generating criminal opportunities in the process. Some of the people attracted to a generator location will notice those opportunities and act on them even though they had not been intending to commit any crime in the first place. Crime attractors are places notorious for providing opportunities for crime. Offenders travel to crime attractors with the preestablished intention of committing some specific crime there (see Brantingham and Brantingham, 1995).

LQCs also have a statistical model-building strength. In many models using crime rates, the independent and dependent variables are both rates based on population. In such instances, the overall

strength of the model may be the result of the same numbers being used as the denominators on both sides of the equation. With LQCs, the independent variable would not have the same base. Independent variables may even reflect routine activities in the LQ form. For example, a measure of the number of bars to total number of businesses in a town can be compared to the ratio for the region under analysis. It seems reasonable that as the local ratio begins to exceed the regional ratio, the LQC for violent crime would also increase. This would not necessarily be found in an analysis of violent crime rates when population is used as the denominator. It might not even be found if the number of bars were used as the denominator in constructing crime rates.

It should be noted that LQCs are ratio variables, and, like all ratio variables, can be influenced by substantial changes when the ratios are calculated from very small numbers. LQCs have a numerator and a denominator. The numerator is the only part of the equation that can have small numbers. For example, when the analysis is of areas with low levels of crime, a change from 20 to 25 recorded crimes of a specific type could have an impact on the calculated value of the LQC when the total local-area crime count is also low. Such a substantial impact might be reflected in local-area fear levels in particular. Such a possibility warrants exploration of past reported crimes in small crime-volume areas. It could be that in small areas with low crime totals, such as city blocks or Census tracts, a three-year average of crime counts should replace an annual total to smooth out fluctuations and ensure stability in the LQC. In fact, LQC analysis using moving averages or autoregressive functions may become useful in time-series analyses that examine the evolution of concentrations of specific types of crime in specific areas. This is worth future research. For example, as an area grows or declines the crime rate might not change, but the crime mix might change quite substantially. This would make the crime problem faced by residents and police alike quite different, even though the volume of crime remained the same. LQCs offer a potential for exploring area crime specialization over time.

While LQCs have many strengths, it is worth noting that this measure, like all other measures of crime, is dependent on a classification schema. That is, limits are introduced when crimes are divided into property/violent clusters, or specific criminal code violations or index crime categories. This is another conceptual level of resolution. While not addressed in this article, LQCs could be used in numerous categories initially or could be staged. They could first be calculated

for violent and property crimes in two categories. After that, violent or property crimes could be divided into subcategories and LQCs recalculated. Each approach would inform the researcher about something slightly different. For example, which specific crimes are different from the general trends, or, within a category such a violent crimes, which types of violent crimes are different from a restricted comparison to violent crime trends. While it will not be discussed in more detail in this article, the hierarchical nature of classification of crimes may reveal fine but important differences between areas.

It is also important to note that there is value in looking at changes in LQC from one time period to another. A change in a specific crime LQC can signal a dramatic change. If the LQC increases it means that there has been a shift in the local *dominance* of that crime. If the LQC for that crime decreases it means that there has been a decrease in the local dominance of that crime. Unlike crime rates or crime counts, LQCs operate within fixed numeric limits. The set of areas forming the full area under consideration will together account for the full area crime totals. There will be areas with LQCs greater than 1.00, less than 1.00 and equal to 1.00. LQCs may go up when total or specific crimes decrease, and may go down when specific crimes go up. The LQC is a relative measure without a dimension. LQCs are like changes in the proportion of persons who die from a specific disease. All people die. When the proportion goes down for one cause it increases for another cause. These proportional changes, such as an increase in a particular cause of death, may occur whether the death rate increases, decreases or remains stable.

Over all, the LQC offers an additional view on crime and potentially has value in understanding crime patterns. Counts and rates are not sufficient; volume dominates both. LQCs are relative measures of crimes that show how a specific area varies from general trends. Context is imbedded within LQCs.

Mapping Crime Patterns: An Illustration

To illustrate the different things that can be learned from analyzing the patterns of crime counts, crime rates and LQCs, we use 1994 data on crimes known to the police in 65 municipal forces in British Columbia. The basic data are population counts, total criminal code offense counts and total violent crime[4] counts for each city. Data were geocoded to Universal Transverse Mercator (UTM) NAD 27, Zone 10 centroids for each municipality using MapInfo for Windows. Maps presented in this discussion were generated using Stanford Graphics and MapInfo.

The substantially different pictures of crime obtained by looking at counts, rates and LQCs are illustrated in Table 2, which presents the top 15 ranked British Columbia cities in terms of violent crime counts, violent crime rates, and LQCs for violent crime.

Violence counts are, unsurprisingly, tied to city size. Vancouver, the largest city and largest policing jurisdiction in the province, ranked first in violent crime counts. Surrey, the second largest jurisdiction, and Burnaby, the third largest, ranked second and third in violent crime counts respectively. Outside the Greater Vancouver area, the other large population centers — including the provincial capital, Victoria, and three large interior population centers — also ranked highly in terms of violent crime counts. These are the hot spots where police and the rest of the justice system will have to deal with a large number of violent crimes and criminals, and where the medical system and insurance schemes will have to deal with large numbers of victims.

This pattern is mapped in abstract two-dimensional form in Figure 1. The axes plot UTM Northing and Easting coordinates. Cities are positioned in their relative locations in geographic space. The view is from the south, looking due north.. There is a major hot spot in the southern part of the province, anchored by Vancouver, Surrey and Burnaby. The black-and-white depiction does not do justice to warm spots in the Okanagan Valley, where Kelowna is located, and on the southern end of Vancouver Island, where Victoria is located.[5] These are the areas that require resources keyed to volumes of violent victimization.

Crime rates, of course, tell a very different story. In this case, rates are calculated by dividing the violent crime counts for each city by its estimated 1994 population. Rates are expressed as violent crimes per 1,000 population. The British Columbia cities with the highest rates of violent crime are smaller cities in the northern and northwestern parts of the province. These areas are depicted as hot spots in Figure 2. Most of these cities are service and recreation centers for large hinterlands: fishers, forest workers, miners and ranchers come to these cities looking for entertainment.[6] Liquor consumption is high and assaults in particular occur with substantial relative frequency.

These cities characteristically have relatively low volumes of crime, but should concentrate crime prevention planning efforts on violence. People in these cities run a much higher risk of violent attack than residents in the larger cities of the southern parts of the province. The crime-count hot spot centered on Vancouver becomes a crime-

rate cold spot once crime per unit volume of population is considered. This pattern is also mapped in Figure 2.

Table 2: Top Ranked Cities for Three Crime Measures

Rank	FORCE	Violent Count	FORCE	Violent Rate	FORCE	Violent LQC
1	Vancouver	8,246	Williams Lake	38.89	North Cowichan	2.96
2	Surrey	4,394	Prince Rupert	35.04	Kitimat	1.95
3	Burnaby	2,216	Quesnel	34.59	Prince Rupert	1.94
4	Victoria	2,041	North Cowichan	33.32	Esquimalt	1.75
5	Prince George	1,961	Dawson Creek	32.78	Mackenzie	1.70
6	Kelowna	1,337	Fort St. John	28.95	Port Alberni	1.65
7	Richmond	1,259	Port Alberni	28.95	Sechelt	1.54
8	Kamloops	1,175	Port Hardy	27.38	Dawson Creek	1.51
9	Chilliwack	1,079	Victoria	27.02	Fort St. John	1.50
10	Coquitlam	952	Prince George	26.12	Smithers	1.43
11	Matsqui	941	Merritt	25.37	Terrace	1.41
12	Delta	858	Langley City	25.33	Kimberley	1.39
13	Langley District	836	Smithers	24.47	Quesnel	1.37
14	Saanich	818	Terrace	22.41	Prince George	1.37
15	Maple Ridge	643	Esquimalt	22.01	Squamish	1.36

Figure 1: Provincial Violent Crime Counts, 1994

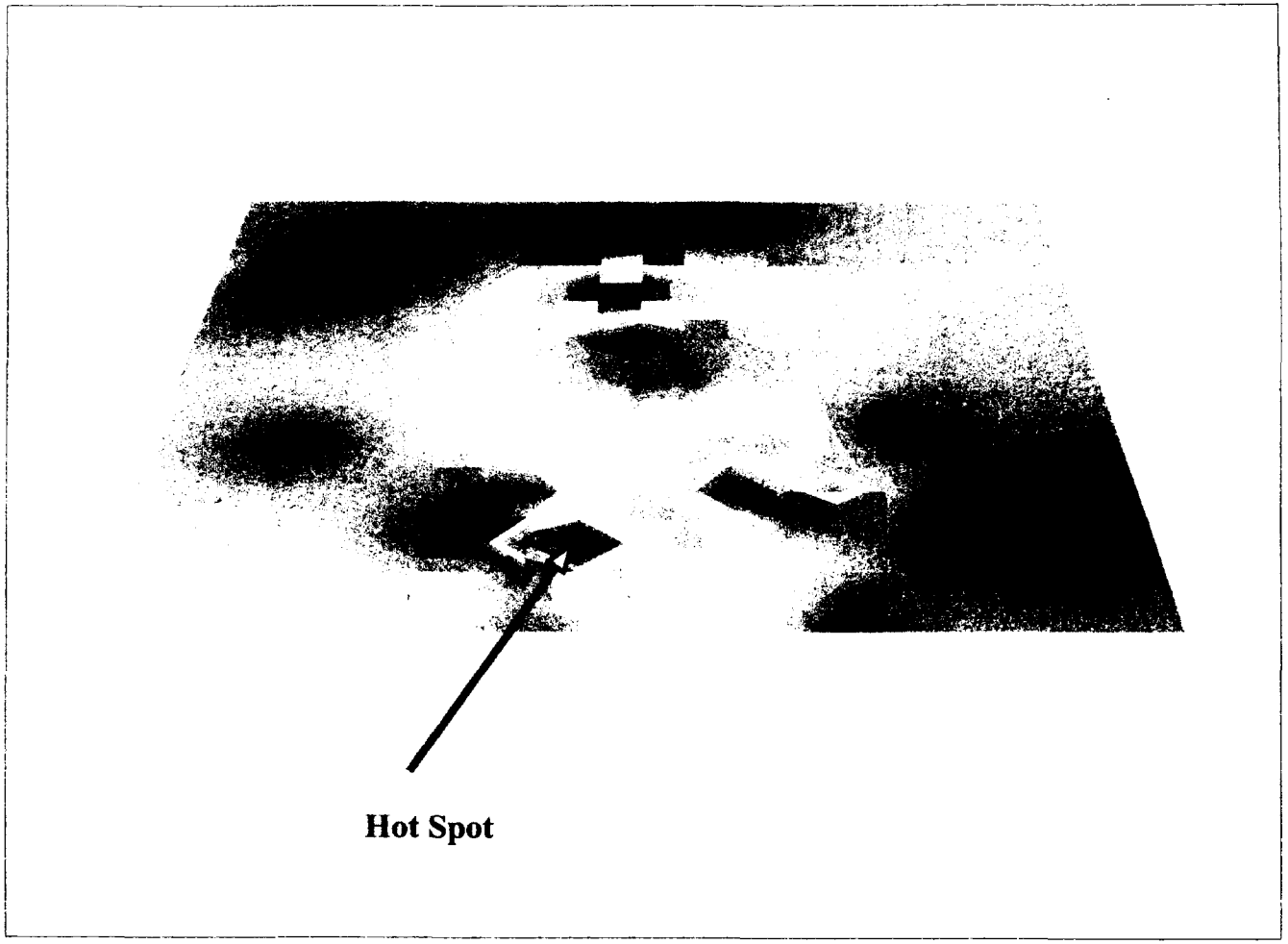
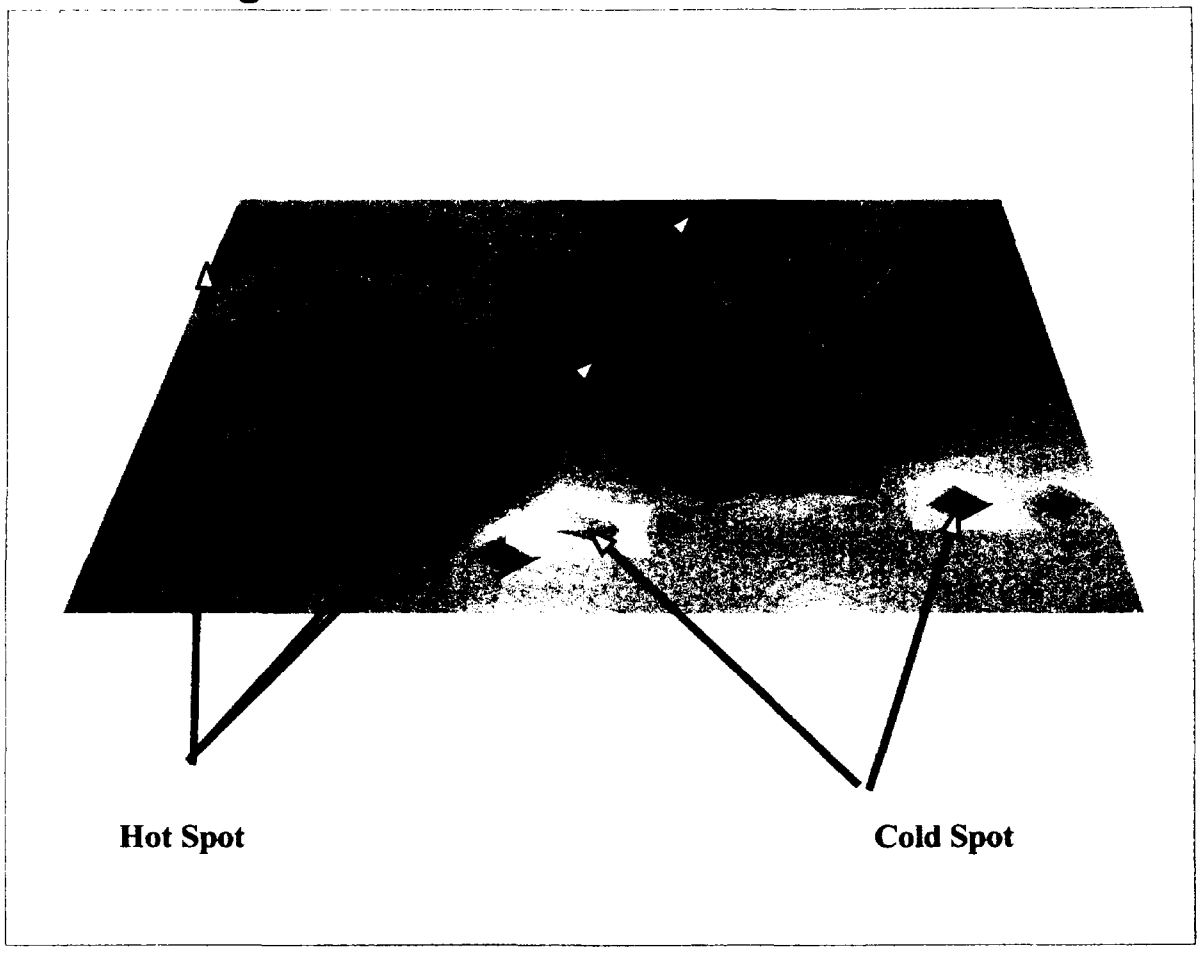


Figure 2: Provincial Violent Crime Rates, 1994



LQCs for violent crime across British Columbia cities tell yet another story. Cities with high LQCs for violent crime are those in which violent crime makes up a much higher proportion of the total crime problem than is characteristic of the provincial pattern generally. Although some high-rate cities will also have high LQCs, many will not. Some cities with relatively low total crime counts and relatively low violent crime rates will have high LQCs because violent crime makes up a disproportionate share of all the crimes that occur in that municipality when compared to the provincial pattern in general. Kitimat, for instance, ranks second in LQC, but only 24th out of the 65 cities in terms of violent crime rates. Kimberly ranks 12th in terms of LQC, but only 46th out of the 65 cities in terms of violent crime rate. This means that although the overall risk of crime is relatively low in these cities, those crimes that do occur are much more likely to be violent ones than in most other cities in the province.

The converse can also be true: some cities will have relatively high violent crime rates, but those rates will be embedded in such high overall crime rates that any particular crime is not much more likely to be a violent crime than it would be in other, far less crime-prone cities. Williams Lake is an example of such a place: it ranks first overall in terms of violent crime rate, but 18th in terms of LQC. Williams Lake's LQC of 1.33 for violent crime indicates that its violent crime mix is above the normal pattern for the province as a whole, but not extremely so. Some cities will have high violent crime counts, low violent crime rates and very low LQCs for violent crimes. Burnaby, for instance, ranked third in terms of violent crime counts, 35th in terms of violent crime rates but 54th out of the 65 cities in terms of LQC. This indicates that a substantially smaller proportion of Burnaby's crime mix involves violent crimes than is typical of the crime mix in the province generally. This means that any particular crime occurring in Burnaby would be less likely to be a violent crime than any particular crime occurring in the province at large. That LQCs and rates tell different stories is apparent from regressing rates on LQCs. Violent crime rates explain only about half the variation in the LQCs.

Figure 3 maps the LQCs for violent crimes for British Columbia cities. The North Cowichan area of Vancouver Island stands out as having a much higher proportion of all its crime take the form of violence than is normal for the province as a whole: it is depicted as an LQC hot spot. A northwestern warm spot is also visible. Violent crime makes up a smaller-than-expected proportion of the crime mix in the

large population centers in Greater Vancouver and the southern part of Vancouver Island, which generally appear as cold spots.

Violent crime counts, violent crime rates and LQCs for violent crime are mapped across the police jurisdictions of the Vancouver and Victoria metropolitan areas in Figures 4, 5 and 6. Violent crime counts show hot spots in Vancouver and Surrey, the two largest municipalities in British Columbia. These counts are population driven. Violent crime rates show a very different picture, with hot spots in the city of Victoria and in North Cowichan on Vancouver Island, and in Langley City, a small suburban bright-lights district in the metropolitan Vancouver district. LQCs show yet a different pattern to violent crime. The entire Vancouver region has relatively low LQCs, indicating that violent crime makes up less of the crime mix in this region than it does in the province as a whole. North of Vancouver, two resort destinations — Sechelt, a coastal community, and the Squamish-Whistler ski-resort area — show violent LQCs that are substantially above provincial levels. On Vancouver Island, the North Cowichan area and the municipality of Esquimalt, adjacent to Victoria, have very high LQCs. These communities experience substantially more violence per unit of crime than the province as a whole.

A more immediate mapping of the differences in the three crime measures is seen in Figure 7, which focuses on the municipalities of Greater Vancouver. Bar charts present first the violent crime count, then the violent crime rate, then the LQC for violent crime in each municipality.[7] Vancouver, the largest city in the metropolitan area, stands out in the left center of the map. Vancouver displays a very high violent crime count, a substantially lower violent crime rate, and a much lower LQC for violence. Although a large number of violent crimes occur in Vancouver, a much smaller proportion of its total crime mix comprises violence than is typical of the province as a whole. This suggests that Vancouver's crime mix is relatively benign (if such a term can ever be applied to a crime problem), and that the city has a more intense problem with property and other types of crime rather than with violence.

Although a more detailed situational analysis would be necessary, it appears that high priority in crime prevention planning ought to be placed on reduction of property offenses and other nonviolent offenses. In contrast, many of the municipalities adjacent to Vancouver proper have relatively low violent crime counts. But of the few crimes that occur in these municipalities, many more are violent than would be typical of the province as a whole. In these municipalities, crime prevention efforts should focus on the violent crime attractors and

generators in an effort to reduce the volumes of situations that support violent crime. Here much can be gained through attention to the problems of violence. This understanding of the need to develop crime prevention programs aimed at reduction of violent crime would be missed if the main focus of crime prevention planning were either the crime counts or the crime rates for these communities. Some of the communities with very low violent crime counts and crime rates would benefit more from attention to violent crime than would other similar-sized communities that have reputations for violence problems but that in fact have relatively low LQCs.

Mapping crime counts and rates and LQCs together can provide very useful visual information that helps identify some important characteristics of local crime problems. It also provides insight into resource needs, crime risks for citizens at large, and the prevention strategies and priorities that could most profitably be pursued.

CONCLUSION

Crimes occur on a backcloth (Brantingham and Brantingham, 1993): at whatever level of analysis is pursued (macro, meso, micro), it is important to see how specific crime type occurrences relate to crime in general. LQCs provide a measure that helps identify whether a specific crime pattern is disproportionately high or low in a particular place or location. While LQCs should not be used without considering counts and rates, they do provide a relative or contextual view of crime and should prove helpful in understanding crime patterns and in developing priorities and approaches in crime prevention.

While not the focus of this article, LQCs should have great value in research into the prediction of crime patterns. Relative socioeconomic and relative activity measures may turn out to be good predictors of crime patterns in ways that more traditional measures have not. The use of LQ measures should make it possible to develop predictor variables that reflect activity, movement and the actual variety in use where different activities occur. Data sources for aggregate analysis can begin to include economic measures, as well as Census and survey information. Mapping relative use measures may prove a particularly useful tool for criminologists and crime prevention professionals alike.

Figure 3: Provincial Violent Crime Location Quotients, 1994

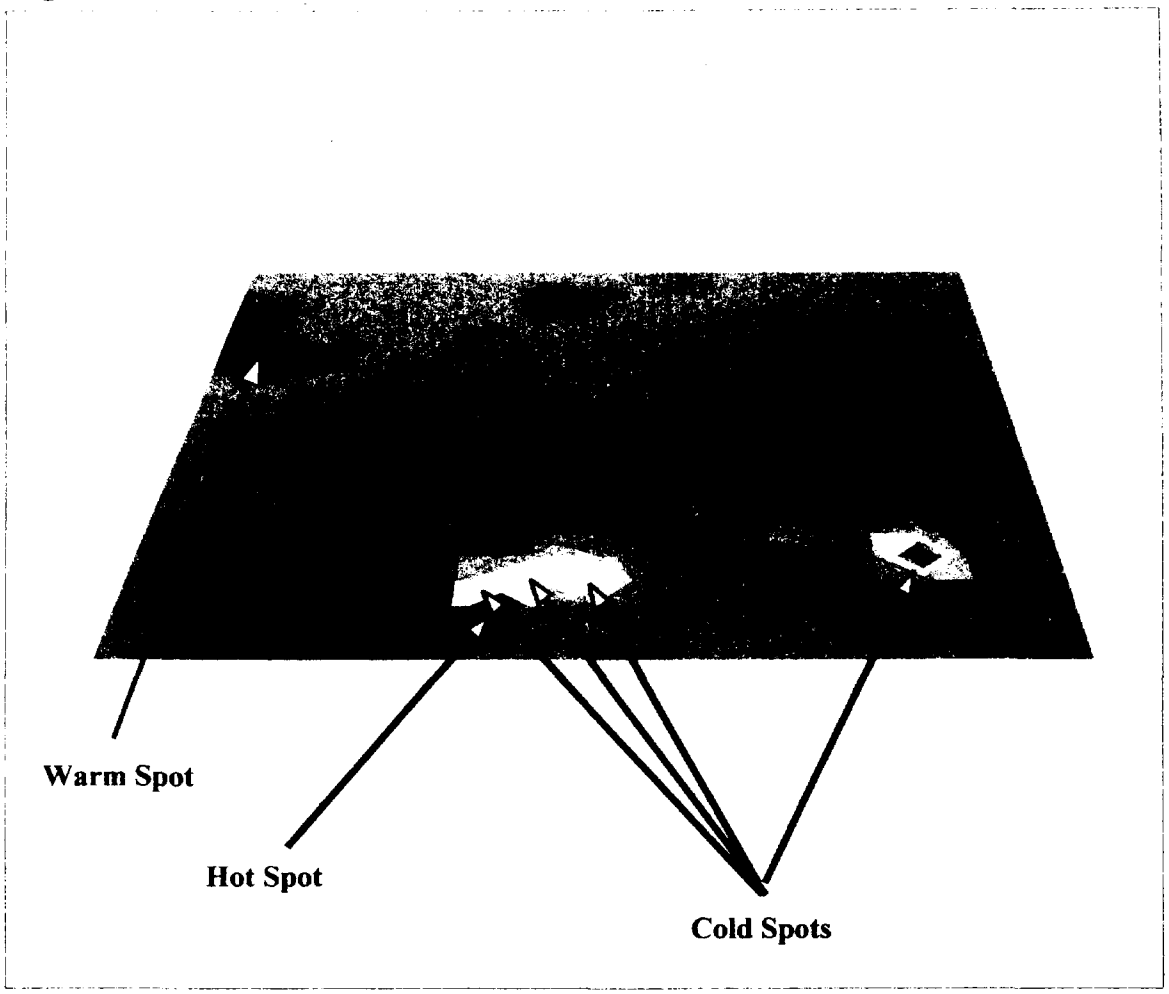


Figure 4: Violent Crime Counts, 1994

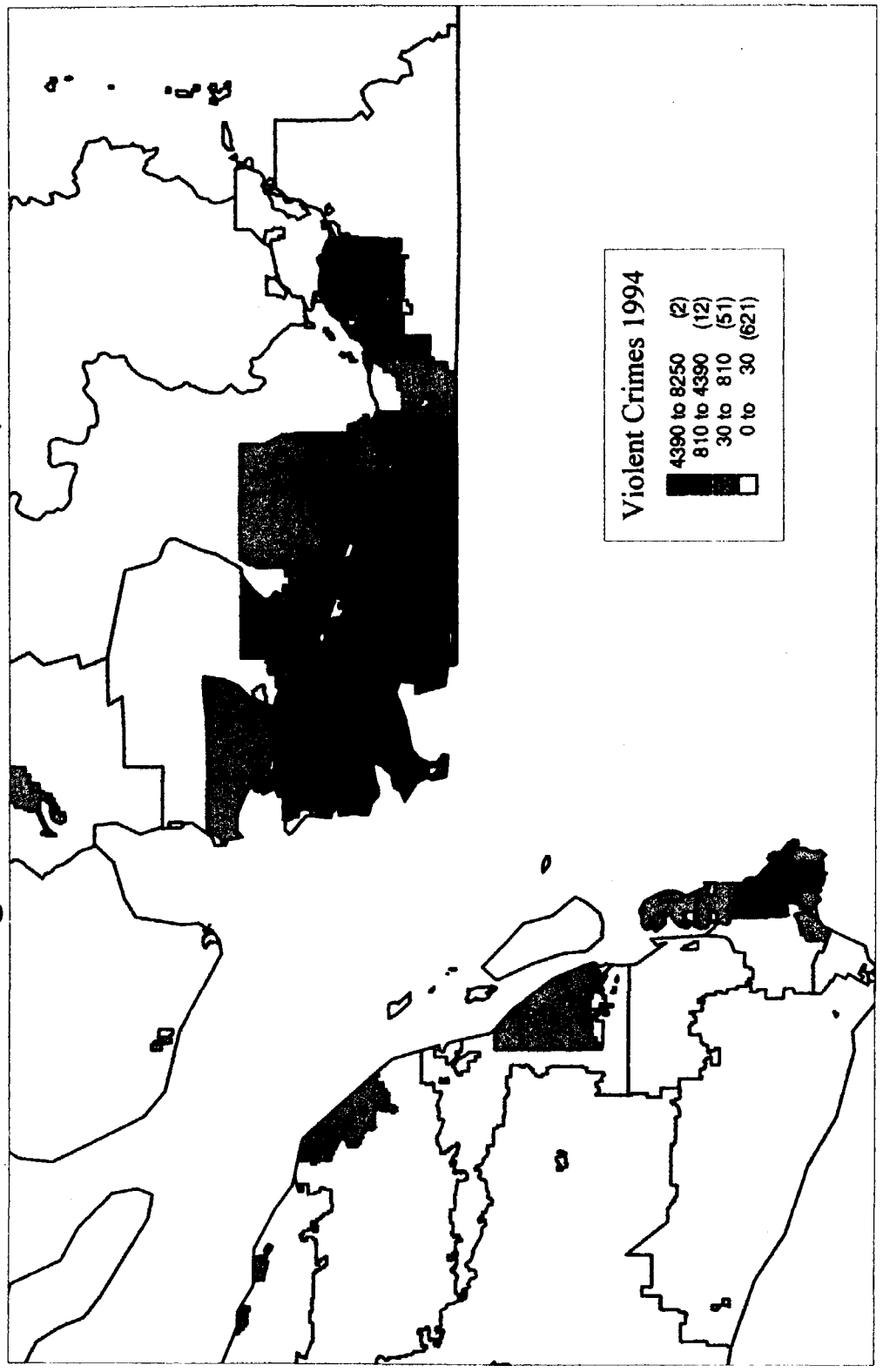


Figure 5: Violent Crime Rate, 1994

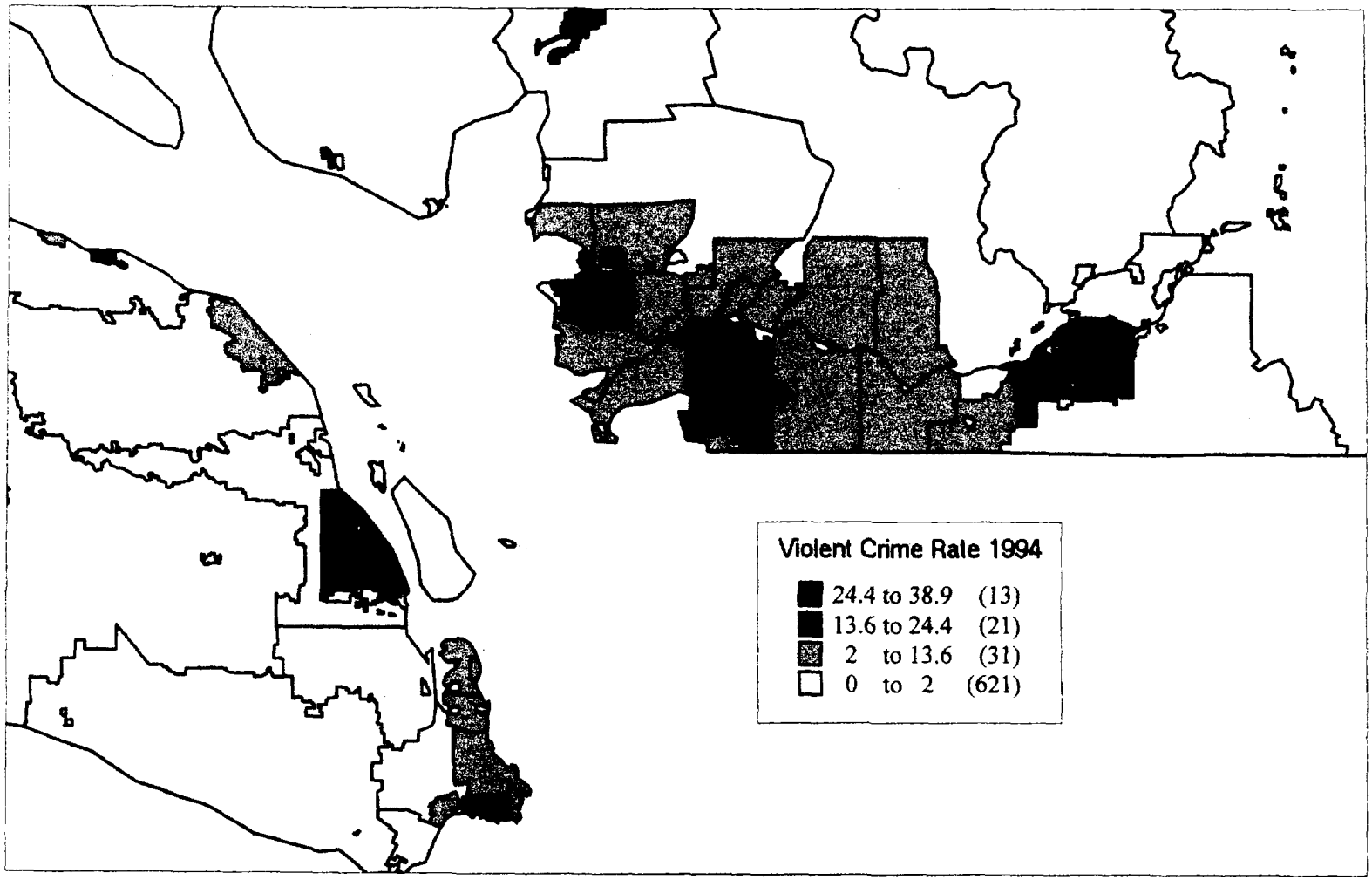
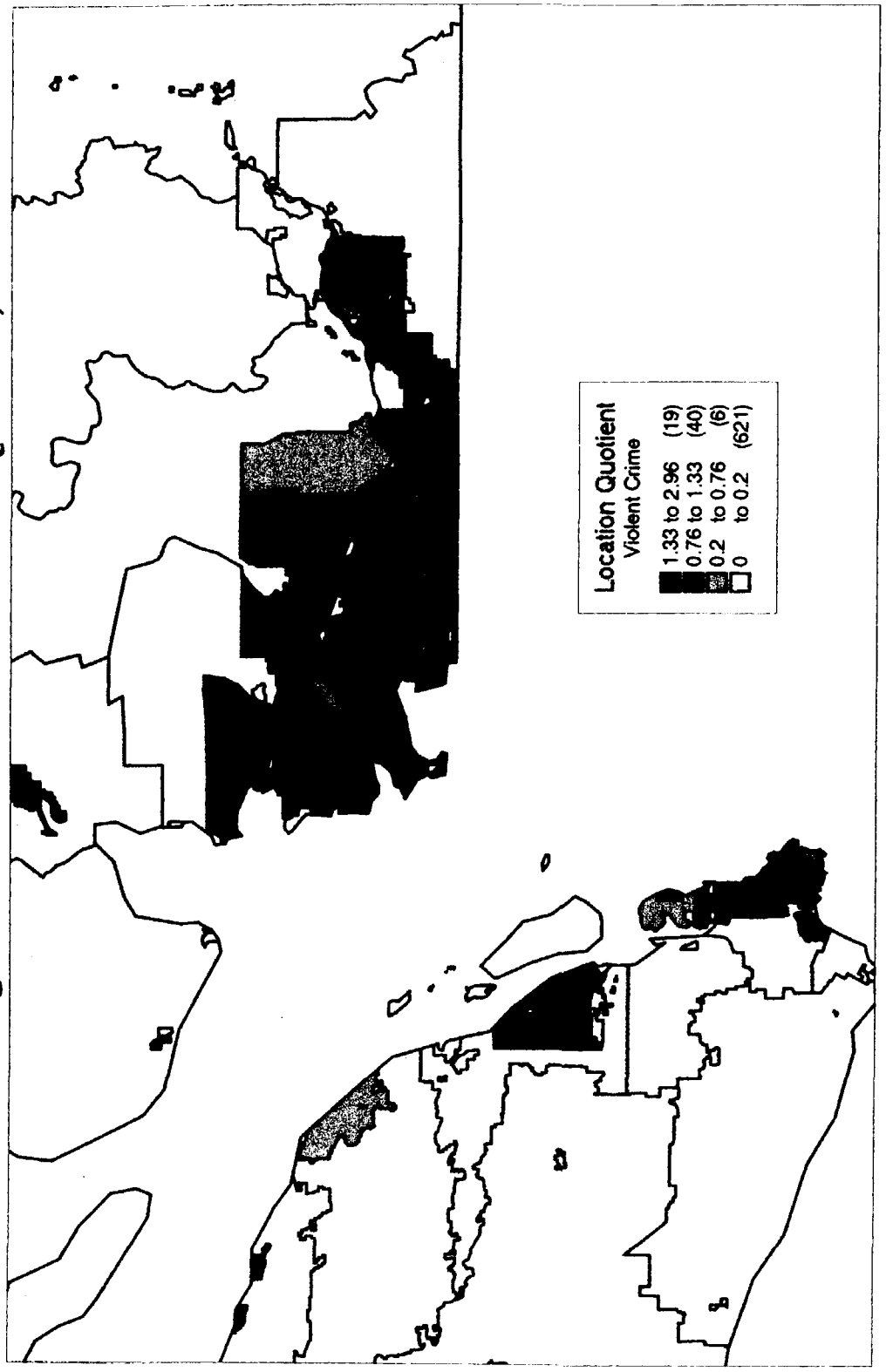
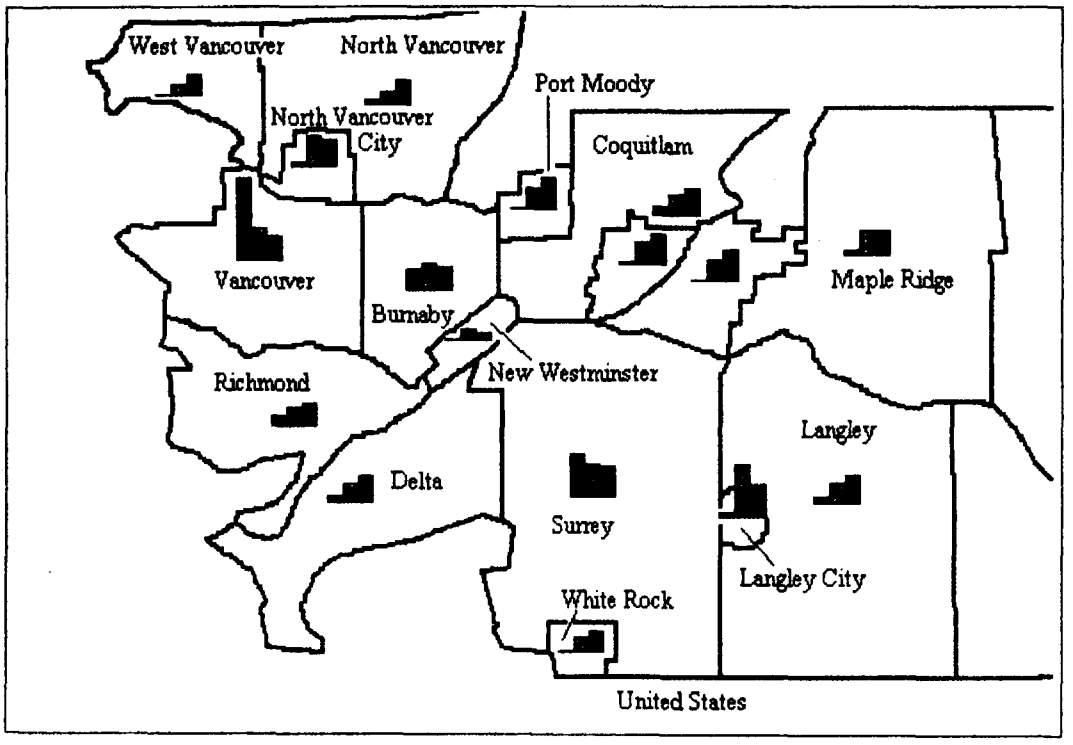


Figure 6: Violent Crime Location Quotient, 1994



New measures are always difficult when they are first used, but LQCs offer criminology a technique that should open many new areas of research using existing socioeconomic data. The LQCs should be particularly important when studying crimes that are dependent on movement and activities. It is always important to remember that a low-crime-rate city may be seen by its residents as a high-crime city for specific crimes. For example, a small town that is a commercial center in a rural area may well experience more property offenses than a surrounding area or a nearby center without a commercial component. A large commercial center adjacent to an even larger commercial center may, relatively, have less property crime. Traditional crime rates or analyses of crime volumes will not find the importance of the activities compared to what surrounds them. LQCs and associated socioeconomic LQs may make such contextual analysis much easier.

Figure 7: Relative Violent Crime Counts, Rates and Location Quotients
Greater Vancouver Municipalities, 1994



NOTES

1. Twelve jurisdictions maintain independent municipal police forces. The remainder contract with the Royal Canadian Mounted Police, who provide municipal policing services through autonomous municipal detachments. A similar arrangement is found in many American jurisdictions. The Los Angeles County Sheriffs' Department provides contracted municipal policing services to a substantial proportion of the independent cities in the county. Other cities in the county — Los Angeles or Long Beach, for instance — maintain their own independent forces.

2. Clearly, the Location Quotient approach has limitations in regional science. With major cities being linked economically, it is not possible to actually identify what activity in a "standard" area would be. This is similar to identifying what a "standard" crime pattern would be. In actual practice, LQs mean more for their relativity and defined context, which is taken as the "standard" for logical purposes.

3. LQC is a relative measure, so the denominator can be flexible. For instance, with robbery in the numerator, the LQC might be calculated using the count of all violent crimes, the count of all criminal code offenses, or the count of all offenses known as the denominator, depending on the context in which the analyst wished to comprehend robbery centers.

4. Violent crime in Canada includes murder, manslaughter, infanticide, attempted murder, sexual assault, assault, abduction and robbery.

5. Most contemporary mapping packages work in color. This is a problem for presentation in print media.

6. This represents one of the denominator problems with crime rates. The actual usage of a city may greatly exceed the resident population.

7. Note that these three sets of bars represent somewhat different scales, as indicated in Table 1.

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