MARIJUANA CULTIVATION IN BRITISH COLUMBIA: USING SPATIAL AND SOCIAL NETWORK ANALYSIS TECHNIQUES TO INFORM EVIDENCE-BASED POLICY AND PLANNING

by

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DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

In the
School
of
Criminology

SIMON FRASER UNIVERSITY

Summer 2006

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Degree: Doctor of Philosophy

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ABSTRACT

This dissertation provides evidence and direction for policy makers dealing with the issue of marijuana production in British Columbia (BC). This document provides a descriptive analysis of the "grow op" industry before moving into a spatial analysis of the effect of police tactical teams (green teams) on grow operations. The final chapters focus on the involvement of organized crime in the marijuana production industry and employ a social network analysis (SNA) framework to illustrate the involvement of different clusters of criminal associations. Using the case of Vietnamese drug production as an example, SNA and geographic information systems (GIS) analyses techniques are combined to assess the spatial and social linkage patterns in statistical and visual terms.

The descriptive analysis of police records shows that marijuana "grow ops" increased dramatically from 1997 through 2000, before levelling out by the end of the collection period in 2003. A significant increase in the number of suspects of Vietnamese origin was also noted. The police hypothesize that Vietnamese criminal organizations have effectively taken over the production of marijuana in certain jurisdictions and that they work with other criminal organizations (i.e. Hells Angels and Southeast Asian Groups) to distribute the drugs.

The results suggest that those areas with specialized anti-grow (or "green") teams show a significant decrease in grow operations in their jurisdiction. Compared to the rate of increase in the period preceding green team implementation, the treatment jurisdictions experienced an 82% decline in marijuana cultivation facilities. Neighboring control areas experienced a 7% increase in grow operations post-treatment.

The network analysis of drug production networks illustrates that the criminal networks involved in drug production are spatially constrained. It also shows that the distance between individuals in the drug production criminal network and their associates varies systematically with network characteristics (centrality measures) but not with demographics or criminal history variables. Of particular importance to police investigation into criminal organizations is the finding that central figures in the network, individuals high in betweenness, degree and closeness centrality, travel farther to associates and place themselves on the geographic periphery of the *network habitat*.

DEDICATION

To my husband, Bryan Kinney. Not only has his strength inspired me, but he has inspired my strength.

ACKNOWLEDGEMENTS

There are several faculty members deserving of my sincere thanks. I would like to acknowledge my senior supervisor, Dr. Patricia Brantingham. Patricia, you are a wonderful mentor and an inspiration for women in academia. Thank you for your confidence and support over the past four years. Dr. Darryl Plecas and Prof. Neil Boyd – I have learned so much about research, and how to have fun doing research, from both of you. Dr. Paul Brantingham – I can't thank you enough for your mentorship and friendship. Dr. Brian Burtch – I learned my most important lesson in academia from you: "it's not what you teach students, but how you treat them that they remember".

On a more personal note, I would also like to thank Nahanni Pollard and Christopher Giles for their wonderful friendship and help through the past four years. But most of all, I would like to thank Bryan Kinney without whom I can honestly say this dissertation would not have been completed.

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1 INTRODUCTION

There is a lack of consensus among the public, government officials, health care employees, academics and several different foreign interests on how the Canadian government should structure drug policy. On one hand, proponents of status quo, prohibition-based policies, maintain that criminal law is the most effective tool to fight what has been termed over the past three decades as the "war" against drugs. On the other, proponents of harm reduction policies assert that drug addiction needs to be addressed through the health care system. The seemingly insurmountable chasm between these two extremes along this drug policy continuum, is sustained by inadequate health care and social science research, moral arguments, and international obligations, among other factors. Despite the conflict, most agree that current prohibitionist drug policies have failed to control drug production, distribution, and consumption. In fact, many contend that current drug policy is ironically counterproductive; it promotes crime, increases the spread of devastating health care issues such as AIDS, and relegates a significant portion of the population to criminal status. The majority of the research conducted on the effect of drug policies supports the harm reductionist position that criminalization not only fails to control drugs, but propagates many social problems, such as crime and poverty. This dissertation focuses on what is arguably a harmful effect of prohibitionist drug policies – marijuana growing operations. In this regard, illicit marijuana growing operations

are considered both as a substantive phenomenon and a criminal justice policy issue.

While the legalization of marijuana consumption receives most of the attention in the Canadian drug policy debate, marijuana growing operations have recently become a primary concern to Canadian policy and law makers. The Government of Canada has to consider many different factors when deciding on policy to reduce the amount of illicit marijuana grow ops in the country. These factors include financial cost, international ramifications, legal boundaries, and research findings. The policy options can be separated into three categories: product-focused, offender-focused, and environmental-focused situational responses.

1.1 Product-Focused Policy Options

1.1.1 Legalization of Cannabis

Legalization is an obvious policy option and the ultimate in harm reduction and liberalization efforts (Albrecht & Van Kalmthout, 1989). The legalization of cannabis could involve regulating possession, trafficking and cultivation of the drug. Under such a scheme, production of cannabis would be controlled by the government. Licences to grow the drug would be sold and profits taxed and returned to the government as is the case currently with cigarettes and alcohol. Proponents of legalization policy liken the current cannabis situation to the alcohol prohibition of the early 20th century, where demand for the illegal substance funded organized crime (Easton, 2004).

Economist Stephen Easton suggests that legalization is the best policy option available to the Canadian government because "marijuana is too easily produced and exported to be controlled with the tools available to law enforcement in a free society," and "for every marijuana growing operation demolished, another takes its place" (2004:3). Easton argues that marijuana cultivation is inevitable in B.C. because of the province's lax enforcement and sentencing of marijuana possession, trafficking and production. Using a series of cost-benefit models, Easton estimates the number of "bustable"[1] grow ops in British Columbia to be around 17,500 and the value of the industry in 2000 to be approximately $715 billion (2004:16-21). He suggests that there is simply too much money to be made and that the consistent demand by users within Canada will continue to fuel the illicit industry. Easton argues that taxing cannabis would effectively transfer the industry profits from organized crime to government coffers. He is correct that the positives of legalization are substantial, and there is much evidence to support the position that marijuana is no more harmful than alcohol or tobacco; however, there are also some powerful negative considerations.

The most obvious critique of this policy centres on the international, and especially American, perception that legalization of cannabis would create. If Canada were to legalize marijuana and the United States remained entrenched in its current prohibitionist policy, the United States would likely hold Canada responsible for much of the marijuana illicitly crossing the borders into the

[1] Easton estimates "bustable" grow ops to have at least 25 plants (2004).

country, regardless of its actual source. It is likely that this blame would extend to cover other challenges encountered by the U.S. criminal justice system involving harder drugs, such as heroin and cocaine—even if these drugs remained illegal in Canada. The United States is Canada's largest trade partner, importing over $223 million of Canadian goods (U.S. Census Bureau, 2003). Policy-makers are likely to see any policy that might damage the relationship with the United States as extremely costly. Legalizing marijuana is also a very politically volatile issue within the country. Many politicians see legalization policy, even when focussed specifically on marijuana, as an extreme position that is unlikely to win votes. Due to the controversy surrounding legalization, politicians and bureaucrats may opt for a less controversial option such as decriminalization.

1.1.2 Decriminalization of Cannabis

The second policy option is the decriminalization of cannabis possession. Decriminalization would mean that possession and cultivation of small amounts of cannabis would not be considered a criminal but a by-law offence and could lead to a fine in the same vein as drinking in a public space. The 2002 *House of Commons Report* advocates this policy option. The positives of decriminalization are fourfold: first, if fines are imposed for use, there would be government profits from these fines; second, in political terms it is substantially less volatile than legalization; third, the current reality of public morality regarding the public use of cannabis would be reflected in the law; and fourth, decriminalization would likely lead to an increased supply, which would, in turn, reduce profit margins for

producers, and ultimately, organized crime. There are many disadvantages that can be associated with decriminalization, but considering that this dissertation deals with illicit marijuana production facilities, or "grow ops", one issue is critical – decriminalization would do little to reduce the number of marijuana growing operations. Decriminalization of possession would not extend to the commercial production and distribution of marijuana. In fact, it would arguably increase demand for the drug. It is naïve to think that most marijuana users would begin to grow their own drug for personal consumption. Furthermore, like outright legalization, a policy of decriminalization would do little to combat the exportation of the product to, or curb demand from, the large U.S. market.

1.2 Situational Policy Options

Situational approaches to crime prevention have been used for the past two decades in many countries around the world. This model of crime prevention stems from research conducted in the 1980s and early '90s through the British Home Office, the United Kingdom's government research unit responsible for criminal justice. The Home Office research, along with problem-oriented approaches to research and policy, where researchers and policy-makers work together to define and solve policy problems, combined to form the theory of situational crime prevention (Clark, 1992, 1997; Paulsen & Robinson, 2004). This perspective involves reducing the opportunity and reward for crime by focusing on specific types of crimes and managing or designing the environment in a systematic way (Clark, 1992).

The first situational initiative discussed in this section is an effort to reduce marijuana growing operations through targeting the illicit industry's infrastructure. Especially for indoor "grows", it is necessary to obtain specialized lighting and associated equipment. This policy option involves changes to the legislation mandating identification and address checks for individuals buying the lights (and possibly attending equipment) most commonly used in marijuana cultivation. There was a somewhat similar crime prevention initiative implemented in Sweden for fraudulent cheque cashing in the 1980s that was very successful (Knutsson & Kuhlhorn, 1997). The second situational initiative involves mandatory electricity usage monitoring. The description, advantages and disadvantages of each of these initiatives are discussed in the next section.

1.2.1 High-Intensity Discharge (HID) Light Regulation

The first situational crime prevention technique applied to marijuana grow ops involves reducing access to specific equipment needed to cultivate the drug. Lighting is one of the most direct ways to track or identify possible marijuana growing operations. There are three types of light bulbs that are commonly available to consumers: incandescent, fluorescent, and high-intensity discharge (HID). Incandescent lights include globe, tubular, reflector and halogen bulbs (General Electric), but none of these bulbs provides the light spectrum needed for plant growth. Fluorescent lights are used in a variety of settings and provide the light spectrum needed for cultivation, but they are not as energy efficient as HID bulbs. HID bulbs are typically used for commercial purposes, such as outdoor lighting of sports fields, parking lots, street lamps, and for security lights

around large buildings. Small HID bulbs are sometimes used domestically to light aquariums and for specialty automotive applications. However, these are also the ideal lights for cultivation. Greenhouse operators use these because they are more energy efficient than fluorescent lights and emit far more light; therefore, less energy is used while at the same time the rate of plant growth is increased. Marijuana growers are well aware of this. Chapter five presents evidence that the vast majority of lights seized from grow operations are HID, with 1000 watt Metal Halide and High Pressure Sodium lights as clear favourites. These lights are available from a variety of sources, but research suggests that hydroponic equipment outlets are the primary supplier of marijuana growing equipment (D. Plecas, A. Malm, & B. Kinney, 2005a). The rate of hydroponic equipment supply outlets per 100,000 population in British Columbia is 2.0, while it is only 0.4 in the neighbouring province of Alberta and 0.2 in Washington State (see chapter 4). The implication is that hydroponic stores are more abundant in British Columbia because of the disproportionately large amount of marijuana growing operations in the province. Considering this evidence, a situational policy solution for marijuana growing operations could be to introduce a regulatory policy to monitor the purchase of 1000 watt HID bulbs in Canada.

A legislated identification and address check for individuals who purchase 1000 watt HID bulbs in Canada will reduce the anonymity of individuals purchasing the lights used by the vast majority of marijuana growers. These lights are specialized and are mainly purchased by municipal governments (for outdoor lighting) and greenhouse operators. The seller would need to see

picture and address identification at the time of purchase, or at the time of receipt in the case of bulbs arriving over the international border. A record of the name, address, use of bulb and number of bulbs would be kept and turned over to the police upon request. The seller would need to account for every bulb being sold. For this measure to comply with privacy legislation and be admissible as evidence in court, a case would need to be made that the public harm of marijuana growing operations outweighs any possible privacy infringement. Considering the very limited consumer base of 1000 watt HID lights and the documented harms caused by grow ops, this should not be a difficult case to make. However, there are still many obstacles to this policy initiative.

The largest obstacle to this option is the cost. For this option to have any hope of working, police would need to investigate the individuals who buy large quantities of lights. A database would need to be maintained, with analysts assisting the police with evidence to support a search warrant. This cost would most likely be justifiable to the police as the cost of the administration of justice, but convincing bulb manufacturers, distributors and store owners will certainly be much more difficult. Additionally, an unintended outcome of this policy might be the growth of a black market in hydroponic growing equipment. This type of black market would likely be attractive to organized crime groups. Another situational policy option involves the monitoring of electricity usage by the province's primary electricity provider, B.C. Hydro.

1.2.2 Electricity Monitoring

The second situational crime prevention initiative involves targeting the electricity used by indoor marijuana growing operations. As the findings of the current study show (see Chapter 4) power diversions represent very few (under five per cent) of the founded[2] grow operations in the province. There is also evidence to suggest that electricity usage over a certain amount per square foot is a fire hazard. Upon confirmation of this preliminary evidence, B.C. Hydro should be legally required to report every owner whose electricity usage rates present a fire hazard. Furthermore, in extreme cases of consistently high levels of electrical consumption in private residence, as most large growing operations would present, the power could legally be turned off in those homes, or at least a possible interruption of service pending a demonstration of need. A bylaw could be enacted that prohibits residentially zoned buildings from consuming excess amounts of electricity without inspection and certification. Bylaws could also provide for high power users to pay fees for this inspection and certification process. Fire codes could also be used/enforced/amended to provide for further enforcement options.

The advantages of this initiative would be that: one, it targets the source of the crime as opposed to the people involved (as people are far less static than the environment); two, its effects could be measured and verified empirically as opposed to legalization and decriminalization; three, there are minimal costs

[2] "Founded" grows represent cases where local police confirm the presence of an illicit marijuana production facility, and are to be distinguished from "reported" or suspected incidences. Founded cases represent the unit of analysis for this analysis. The ways in which police act on public tips, or discovery of suspect facilities are discussed more fully in subsequent chapters.

involved compared to increased criminal justice system initiatives; and finally, it would not require changing a law, rather it would require adapting and enforcing current building fire codes.

The major disadvantage to this plan, and to most situational crime prevention strategies, including the solutions presented in this paper, involves displacement and innovation. Displacement is well researched in the situational crime prevention literature (Clarke, Belangerand, & Eastman, 1996), but for present purposes it is sufficient to define it as the movement of one type of crime or offence to another form, location or situation. Electricity monitoring may displace grow operations to other provinces or jurisdictions with less rigorous monitoring regulations. Marijuana growers, particularly those involved in criminal organizations, may choose an adaptive or innovative response that arguably, could be more dangerous to public order and security than the original offence. Power diversions, as an evasion tactic, are especially concerning, as such work is unlikely to be done "to code" or in a professional, or safe manner. Also, the situational policy initiatives could be criticized as not addressing the disjuncture between the reality of how many people use marijuana and prohibition of the drug. It appears that even if the general public does not support public use of marijuana, it appears unwilling to actively censure those who do. If this situation is a fair assessment, then it would seem that the current legal position of prohibition is out of synch with current mores of tolerance, and is ripe for reconsideration. The following section considers offender-focused policy options

aimed at increasing the criminal justice system prohibition and response to cultivation.

1.3 Offender-Focused Policy Options

1.3.1 Tougher Sentencing

It could be suggested that if possession of cannabis for personal use were decriminalized, then it should follow that sentencing for trafficking and production of the substance become more onerous. Tougher sentencing would likely mean an increase in the use of a combination of more custodial sentences and more (and heavier) fines. If more serious sanctions were advocated, the clearance rates (for individuals charged with marijuana production would likely increase. This option would be politically palatable—as most governments are apt to position themselves as "tough on crime"—and could even serve to deter criminals providing the sentencing changes were made public, enforced and perceived to be meaningful.[3] However, the costs involved with massive increases in court time, increased custodial care and increased police time during investigations would be a disadvantage of this option.

1.3.2 Intelligence-Based Policing

In the past twenty years, intelligence-led policing has become a catch-phrase for techniques used to police criminal organizations. Most police units investigating organized crime claim to be using intelligence-led techniques, but

[3] The most current manifestation of this "getting tougher" on crime orientation can be seen in two of the federal (Conservative) government's crime Bills (C-248 and C-235; see URL ref: http://www.parl.gc.ca [accessed April 3, 2006]). Bill C-248 specifically calls for increased sentencing minima for trafficking and exportation of controlled substances like marijuana.

many critics suggest that this is more rhetoric than actual practice (Cope, 2004; Jerry H. Ratcliffe, 2002). While there is research describing organized crime and its effects, there is a lack of research describing strategies used to police organized crime and even less research evaluating those strategies. These strategies include: network and linkage analysis; security and foreign intelligence agencies dedicated to policing organized crime; communication and semantic analysis of criminal networks; and specific problem-oriented policing techniques.

Intelligence-led policing responses to marijuana cultivation take several forms. First, it is a safe political platform both internationally and domestically; second, a strategic, directed use of resources could be brought to bear on organized crime at its core; third, crimes other than cultivation may decrease as a result of the threat of this increased scrutiny. The negatives associated with intelligence-based policing are that the costs associated with case complexity and mega-trials are often excessive and even prohibitive. Many of the intelligence-led techniques are still in their infancy and clear evidence of their impact on criminal organizations is not, as yet, understood.

As seen through the course of this dissertation, the problem of marijuana grow operations is complex. Ultimately, a combination of several different options, supported by evidence-based policy and planning, may be the best solution. Regardless of the nature of any policy adjustments, it is critical that they be based on a consideration of empirical evidence—both of the current situation, and a careful forecasting of future impacts.

Since it is impossible to evaluate and discuss all of the policy options mentioned in this introduction, the remainder of the dissertation focuses on describing the nature and scope of the problem and then using current spatial and network analysis techniques to evaluate intelligence-based policing policy strategies.

1.4 Dissertation Outline

The purpose of this dissertation is to provide evidence and direction for policy makers in dealing with the issue of marijuana production. Initially, the concept of evidence-based policy and planning is discussed. Obstacles to this form of decision making and the role of stakeholders are presented in this chapter. The methodology chapter outlines the methodologies used in this research. This chapter is separated into three sections: the first details the data collection methodology, the second outlines the techniques used in the spatial analysis of grow operation locations, and the third section summarizes the network analysis methodology. Chapter four presents a descriptive analysis of marijuana grow operations in British Columbia. This descriptive analysis is important because it details the scope and nature of the problem. The next chapter continues presenting results, albeit in a different vein than the previous chapter. Chapter five presents a spatial analysis of the effect of police tactical teams (green teams) on grow operations. The final results chapter, chapter six, focuses on the involvement of organized crime in the marijuana production industry. This chapter uses social network analysis to illustrate the involvement of different criminal organizations. Chapter six also integrates social network and

geographic analysis by utilizing two of the most common methods of displaying social and spatial networks - computer-generated visualization webs and maps – using the case of Vietnamese drug production as an example. The integration of these two techniques could substantially improve the tools available to those studying the patterns of organized crime. Finally, the conclusion summarizes the main points of the dissertation, the strengths and weaknesses of the research, and offers suggestions for future research.

2 EVIDENCE-BASED POLICY AND PLANNING

Evidence-based policy and planning is a paradigm for decision-making that is becoming increasingly popular in the western world. The global nature of problems in policy areas such as health and criminal justice yields an increased need for a reliable evidentiary base upon which to build policy. Although the magnitude of these challenges is daunting, it has had the positive effect of causing governments and institutions to act. Custodians of data repositories have made existing data more available, while supporting efforts of researchers to gather new, targeted data to inform governments and their policy makers. As a result of the need for such evidence, university and researchers are becoming increasingly involved with governmental agencies and external organizations in the enterprise of evidence-based policy and planning.

Criminal justice issues can be (and often are) laden with emotion, morality and vested interests. In an effort to limit these forces, evidence-based policy and practice play a key role but, as with any social issue, complete objectivity is very difficult—if not impossible—to achieve. In this chapter, the author attempts to reconcile these obstacles with the overwhelming need for solid evidence of what works in the criminal justice system. The first part of this chapter defines what is meant by evidence-based policy and planning. The second part outlines the obstacles encountered when employing evidence-based policy and planning in the criminal justice system. The third part discusses the important role of

stakeholders in this initiative. When defined and used correctly, evidence-based policy and planning is the most effective tool criminal justice policy makers have to make informed policy decisions.

2.1 Evidence-based policy and planning: What does this mean?

It is important to define the term evidence-based policy and planning and its components as it is often misinterpreted and misused by both policy-makers and researchers. The term *policy* is defined as a "decision by government concerning a repeated intervention" (Maclure & Potashnik, 1997:136). Majchrzak (1984) wrote that policy research is the practice of conducting research on "a fundamental social problem in order to provide policymakers with pragmatic, action-oriented recommendations" (quoted in Thompson, 2001: 63). In this chapter, *evidence* is defined as the result of interdisciplinary research with systematic, open, accountable and logical research decisions. While the randomly-sampled, control-group design has been preferred by health researchers, cost-benefit analyses and methodologically rigorous program evaluations are recognized as important contributors in evidence-based criminal justice policy and planning. The relevance and importance of research are defined by the stakeholders. These issues are discussed further in the latter sections of this chapter. Evidence-based policy and planning practitioners essentially ask: Is there evidence to support this policy or program? The next section sets out the formal origin of evidence-based policy. It is argued here that

the best way to limit subjectivity, be it moral or value judgements of certain groups for or against another group, is to identify, collect, and analyse.

One of the first pieces of literature in evidence-based policy is Donald T. Campbell's *Reforms as Experiments*, a groundbreaking work in social policy experimentation (1969). Despite this early effort, it was not until the early 1990s, with evidence-based medicine, that one sees a real emphasis on evidence-based policy in the literature. Evidence-based medicine is a paradigm for decision-making that stresses the importance of "scientifically designed experiments in clinical settings (randomized control trials), with a lesser emphasis on non-randomized (observational) studies, and the least emphasis on unsystematic clinical observations and expert opinions" (Maclure & Potashnik, 1997:134). A short time later, in 1993, the Cochrane Collaboration was founded. This collaboration is dedicated to producing and disseminating systematic reviews of "health care interventions and promot[ing] the search for evidence in the form of clinical trials and other studies of interventions" (*The Cochrane Collaboration*). In 2000, an international group of academics formed the Campbell Collaboration. This group has the same goals as the Cochrane Collaboration, but is focused on the areas of social and educational policies and practices (*The Campbell Collaboration*). Given its close relevance to criminal justice policy, it is worth reviewing its objectives. The goals of both organizations are:

1. Collaboration, by internally and externally fostering good communications, open decision-making and teamwork.
2. Building on the enthusiasm of individuals, by involving and supporting people of different skills and backgrounds.

3. Avoiding unnecessary duplication, by good management and co-ordination to ensure economy of the effort.
4. Minimizing bias, through a variety of approaches such as abiding by high standards of scientific evidence, ensuring broad participation, and avoiding conflicts of interest.
5. Keeping up to date, by a commitment to ensure that Campbell Reviews are maintained through identification and incorporation of new evidence.
6. Striving for relevance, by promoting the assessment of policies and practices using outcomes that matter to people.
7. Promoting access, by wide dissemination of the outputs of the Collaboration, taking advantage of strategic alliances, and by promoting appropriate prices, content and media to meet the needs of users worldwide.
8. Ensuring quality, by being open and responsive to criticism, applying advances in methodology, and developing systems for quality improvement.
9. Continuity, by ensuring that responsibility for reviews, editorial processes and key functions is maintained and renewed. (*The Campbell Collaboration*)

Both collaborations are committed to ensuring strict methodological rigour on the research it includes in reviews, or as they are more formally known - meta-analyses. While the task of cataloguing and analyzing published research is a worthwhile effort, it is possible to use the same methodological criteria for both the natural (Cochrane) and social (Campbell) sciences for applied questions of criminal justice policy. In this regard, items four (minimizing bias) and six (pragmatic policy) are especially relevant to criminal justice planning. But before one can build bridges between natural and social science models of systematic inquiry, it is first necessary to understand something of the chasm that is often said to separate them.

Clearly, then, there are some important differences between the natural and social sciences that evidence-based policy analysts must consider. The philosophy of science needs only a brief introduction here. In the natural

sciences, experimentation is concerned with the testing of hypotheses. Von Leibig (1863) wrote, "experiment is only an aid to thought, like a calculation: the thought must always and necessarily precede it if it is to have any meaning" (quoted in Tilley, 2000: 195). However, no experiment can occur in a "theoretical vacuum", as illustrated by Sir Karl Popper (1959):

> The empirical basis of objective science has nothing "absolute" about it. Science does not rest upon solid bedrock. The bold structure of its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not to any natural or "given" base; and if we stop driving the piles deeper it is not because we have reached firm ground. We simply stop when we are satisfied that the piles are firm enough to carry the structure, at least for the time being. (quoted in Tilley, 2000: 196)

The natural scientist controls the context of the experiment by initiating a series of regularities based on a (usually) longstanding theory that, itself, has been previously tested in an equally controlled laboratory setting. Research in the social sciences necessarily has less control and regularity when held to this standard, as is the nature of the social world. These differences can be generalized into four aspects of social science experiments:

1. The context for social science is generally more dynamic than natural science and is harder to quantify objectively.

2. Natural scientists conduct experiments in closed and controlled contexts, while social scientists often conduct experiments in open and dynamic ones.

3. There are many variables studied in social science at the same time, while experiments in the natural sciences often isolate one specific variable to test.

4. Theories in the natural sciences have been extensively tested in a variety of experimental contexts; this is less the case in the social sciences. (Tilley, 2000)

Given these differences, social scientists have relied upon the randomly controlled trial to instil some of the experimental control achieved in the natural sciences.

Randomly controlled trials involve creating two or more groups within the same social context. Individuals will be randomly assigned to a control group that will not involve any treatment, the other randomly assigned group(s) will be given a treatment(s). After this assignment, it is typical to conduct pre and post tests across a range of variables of interest. However, there are some research settings, such as with most policy questions, where the randomized control trial is not appropriate. In such situations, however, must one abandon as inappropriate all research that does not conform to one epistemology?

In the United Kingdom, the Home Office[4] has worked on criminal justice research initiatives with over a hundred in-house researchers and a number of university-based academics for over a decade. There are similar departments in other countries, but the Home Office is arguably the most comprehensive partnership between academics and policy makers in criminal justice in the world. Almost without exception, Home Office research has never relied on the randomized control trial (Tilley, 2000). Despite this seeming lack of systematic rigour, their research and program evaluations use realistic context and often include complex longitudinal elements. The researchers have been successful in producing reliable results without the use of strict experimental or randomly controlled research and these findings have been used by policy makers. Taking

[4] The government department responsible for criminal justice in the United Kingdom.

this into account, neither the classic experiment nor the quasi-experimental randomly controlled study can adequately summarize all quality research in criminal justice. This creates a problem for those who want to impose strict rules on what is considered "quality research".

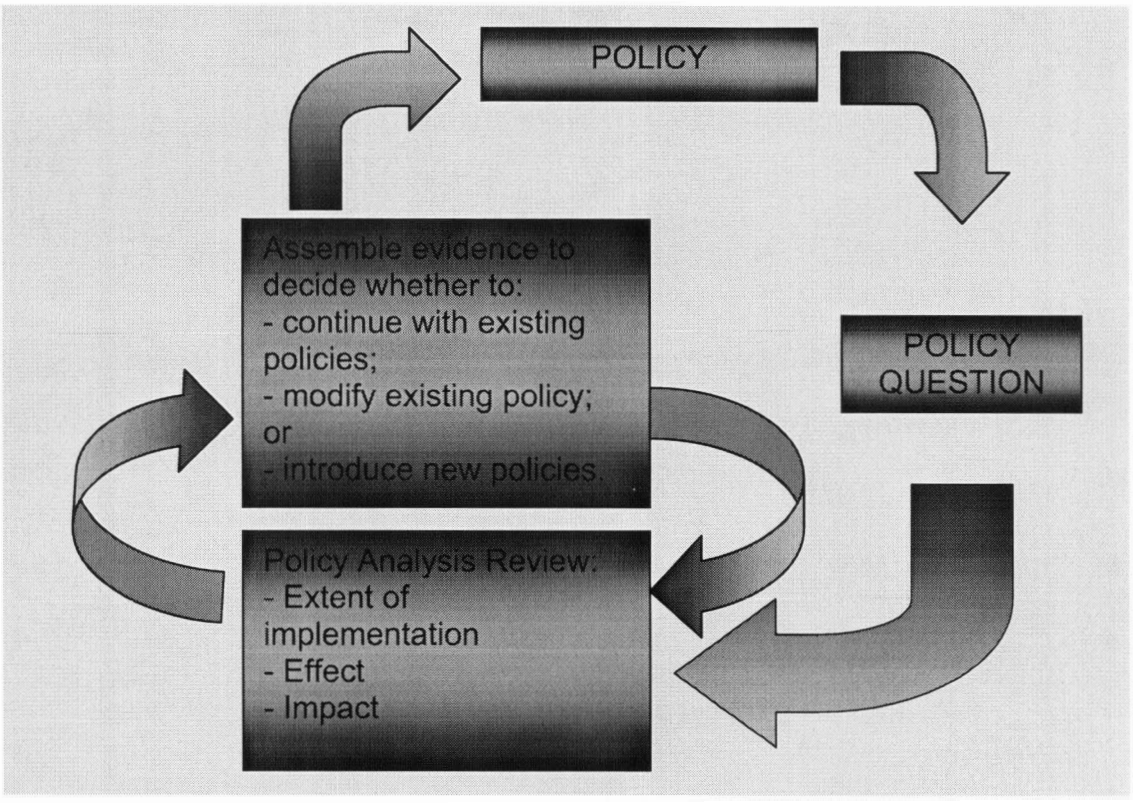
Returning to the summary of the Campbell and Cochrane mentioned above, it would seem that the most promising approach to policy design is to incorporate as many different evidence-based research methodologies as possible for any given initiative or program evaluation. By bringing to bear a methodologically diverse *collaboration*, it is less likely that the end product will be blinded by any one particular approach, philosophy of science, or source of data. In short, epistemological rigour can be best prepared by sampling diverse sources of evidence, in a multi-method research and planning design. For the topic at hand, one could see that marijuana production (and controlled drugs and substances policy in general) would be most fruitful if more than legal issues (and its attending experts) meet to discuss policy options. Medical teams, social policy analysts, economists and the like would all help create a more complete (and therefore more scientific) picture of "all available evidence". Using these as the pillars, to borrow Popper's metaphor, we can build a solid policy foundation for marijuana legislation in Canada. Many other techniques, including current crime analysis methodologies, could be used in the evidence collection phase of the cycle described below.

2.2 The Evidence-Based Policy Cycle

The evidence-based policy cycle is iterative and does not have a definite starting point, although most researchers are brought in at the stage after the policy question has been developed (see Figure 2.1). The precursor to question construction often takes the form of cooperative informative inquiry (Heron, 1996), where all of the stakeholders meet to share information on the issue at hand. The outcome of these meetings, a descriptive report, informs policy question formulation (Charles & Glennie, 2002). The policy question explicitly states what it is that the policy-maker wishes to know. In other words, it specifies the rules for inclusion for what sets of measurable observations should the researcher gather as evidence. Clearly, the formulation of this question is integral to the whole process as it defines what is in, and perhaps more importantly, what is out of scope. This rule-making process often requires intensive consultation between the various stakeholders and researchers. When the definitions are not clear the researchers could misinterpret the issue, or find themselves working with a policy question that is not answerable.

The next stage in the cycle is the policy analysis review, where the extent of the implementation of the policy, the effect of the policy and the impact of the policy is assessed. The researcher must then assemble evidence in order to decide whether the policy should be kept "as is", modified, or abandoned in favour of a new policy. This process is iterative in the sense that the policy should be assessed over time, even if the eventual, evidence-based decision, is to keep the policy as is.

Figure 2.1: Evidence-based policy cycle



Source: Adapted from (Hornby & Perera, 2002: 171)

This process can only occur if there is: a functioning information system; a capacity for data analysis and interpretation; a mechanism for communication between researchers and agency; and policy choices are made on the basis of evidence and not emotional or moral grounds (Hornby & Perera, 2002). These and other obstacles to evidence-based policy and planning are discussed in the next section.

2.3 Obstacles

The ideal evidence-based decision-making structure is incredibly difficult to put into practice. It takes much more than an interested group of policy

makers and eager academics. Graham Leicester identifies seven "enemies" to evidence-based policy:

1. bureaucratic logic;
2. the bottom line;
3. consensus;
4. politics;
5. civil servant culture;
6. cynicism;
7. time, or lack of it. (1999: 5)

The first obstacle, bureaucratic logic, considers things to be right simply because they have always been done that way. The second obstacle, the bottom line, is the "logic of the business environment" and is based on an estimate on measurement of costs, although this says nothing of the quality of service (Leicester, 1999: 5).. The next barrier, government pragmatism, is often based on a "whatever works" policy; however, this pragmatism is not based on evidence as much as consensus of stakeholders (Leicester, 1999: 5). The real danger from a policy formation point of view is that stakeholders may rely on items one through seven in building their assumptions rather than the available (and possibly alternative) evidence. The fourth difficulty, politics, has little to do with evidence; in fact it often directly opposes what the evidence suggests. As described by public choice theory, both bureaucrats and politicians are accused of self-interested rationality. Most bureaucrats seek to "maximize their departmental budgets, and politicians to maximize their chances of re-election" (Borins, 2000: 4). Both of these influences tend to reward status quo, and punish innovation, including the development of new lines of policy, new ways to test existing policy or the use of alternative data sources for evaluation of the same.

The fifth and sixth obstacles, civil service culture and a culture of cynicism, underlie the distrust of any information that is generated, collected or analyzed outside of the system. The final enemy, time, is self explanatory, as Leicester observes, "no wonder there is so little room for evidence-based policy: there is scarcely room even to think" (1999: 6).

Science, both natural and social, is vulnerable to attacks from bureaucracy and vested interests. These interests "exploit scientific uncertainty" and detract from actual knowledge to support their personal opinions and gains (Rosenstock & Lee, 2002: 14). The university is increasingly looking toward industry and government for research funding, but this funding may come with emotional, ideological and political ties discredit academic, scientific research (Rosenstock & Lee, 2002). Vested interests use tactics such as economic manipulation, delay, hidden identities, and even harassment to attack research that does not support their agendas (Rosenstock & Lee, 2002). Responses to such attacks include considering the attack's source and context, diversifying partnerships both in and outside of the academy, ensuring transparency of funding sources, and setting standards for partnerships and publication (Rosenstock & Lee, 2002). The evidence-based research paradigm also provides another layer of protection for the agency seeking information as these agencies can point to (relatively) objective measurements that are free from self-serving bureaucratic bias (or spin). More crucially, the persons called upon to conduct the research are protected from attacks in the form just mentioned by virtue of the relatively

transparent, formal negotiations that set out the specific policy question in the first stages of the research design.

One obstacle that has not yet been mentioned, but deserves particular attention is public opinion. Public opinion is especially counterproductive to the foundation of evidence-based policy in settings where the issue highly contested across moral lines. Issues with strong moral elements, such as the current drug policy debate in Canada, pose the question: is it evidence-based policy or policy-based evidence (Marmot, 2004)? Should public opinion matter in policy making? Or does consulting the public provide a "democratic justification for policy" (Dawson, 2004: 3)? Angus Dawson, in his article on the debate surrounding human fertilization, a very heated moral debate, suggests that consulting the public on policy topics, particularly morally-laden issues, is a mistake (Dawson, 2004). He states that just because a majority of the people prefer one policy initiative to another, does not mean that the policy is right, the majority of the population could be incorrect. The public is not the only group whose opinion could be flawed; all stakeholders involved in the process, by definition, have a vested interest in the outcome.

2.3.1 Stakeholders

Understanding the role of stakeholders in the process of evidence-based policy and planning involves briefly exploring some of the primary theories of policy decision-making. The Advocacy Coalition Framework was developed by Sabatier in 1993, and continues to be one of the most influential theories within policy decision-making circles. This theory contains four basic premises:

1. a time period of approximately ten years is needed to understand policy change and decision-making;
2. policy change and decision-making is best understood by focusing on policy subsystems – a group of actors from different institutions who aim to effect governmental policy decision-making in a particular policy area – or stakeholders;
3. policy subsystems must include an intergovernmental element – representation from all levels of government; and
4. public policies are similar to belief systems, in that policies have value priorities and assumptions about how to realize these priorities (Fenger & Klok, 2001; Sabatier, 1998; Sabatier & Jenkins-Smith, 1993).

Advocacy coalitions are individuals from different areas (i.e. government, agencies, and research) who share a particular epistemology and who show a "non-trivial degree of coordinated activity over time" (Sabatier, 1993: 25). Schlager adds to Sebatier's theory by suggesting that actors with a shared belief system are more likely to agree on the policy question, definitions, and policy structures if they "interact repeatedly, experience relatively low information costs, and believe that there are policies that, while not affecting each actor in similar ways, at least treat each other fairly" (Schlager, 1995: 262). This approach is similar to the Cochrane and Campbell methodologies mentioned earlier—a formal privileging of multi-agency and multi-method teams of planners and practitioners over the uni-modal research efforts that are typical of closed bureaucratic systems or institutions.

The second approach, policy network analysis, identifies stakeholders as individuals who have some knowledge about the policy issue and questions surrounding the issue. According to network analysis, subsystems of these stakeholders who have a similar policy discourse, or shared belief system, are known as a discourse community (Bulkley, 2000; Howlett, 2002; Singer, 1990). Several policy theorists discuss the notion of shared belief systems, often using different terminology, as meaning a collective method of approaching and dealing with a specific policy issue. Hall (1993) uses the term "policy paradigm" and defines it as a "framework of ideas and standards that specifies not only the goals of the policy and the kinds of instruments that can be used to attain them, but also the very nature of the problems they are meant to be addressing" (quoted in Legro, 2000: 421). Ellingson (1995) uses the term "discourse" in a similar vein and defines it as a "set of arguments organized around a specific diagnosis of and solution to some social problem" (quoted in Legro, 2000: 421). Another subsystem of stakeholders known as an interest network consists of individuals who exchange information between one another regardless of their discourse community (Howlett, 2002; Pappi & Henning, 1999). If the communities and networks are closely intertwined, new ideas and new stakeholders will find it difficult to enter the policy process (Howlett, 2002). If the discourse communities are varied, as often found in interdisciplinary research, the policy process is far more open (see Table 2.1).

Table 2.1: Preliminary Operationalizing of Policy Subsystem Configurations

Extent of symmetry between community and network	Network's degree of insulation from community	
	High	**Low**
High	Closed Subsystem	Resistant Subsystem
Low	Contested Subsystem	Open Subsystem

Source: (Howlett, 2002: 250)

Evidence-based policy and planning would be more achievable in an open subsystem. The final stakeholder in this process, the researcher, especially those external to the system, would find it difficult to penetrate a closed or resistant subsystem of government and agency stakeholders. Since the researcher's role in evidence-based policy is to "monitor, evaluate and adjust continuously" (Leicester, 1999: 6), ideally the researcher should be involved at every level of the policy decision-making cycle. The researchers need to be close enough to the discourse community and interest network to gain from their knowledge and experience, but distant enough to keep independent and unbiased. Therefore, the key to evidence-based policy and planning is a relatively open subsystem of bureaucrats and academics who hold their trust but are still distant enough to keep from being biased.

2.4 Conclusion

While evidence-based policy and planning has been around for decades, it is just beginning to burgeon in the area of criminal justice policy. Evidence-based policy has many obstacles to overcome, but it is becoming more realistic in the areas where:

1. the stakes may be high, but the decisions are simple, repetitive and unrushed;

2. the policy-making structures and processes are tailored to evidence related questions;

3. the tasks are not too varied, complex or vague;

4. the outputs are written, exposed to criticism, and disseminated to stakeholders. (Maclure & Potashnik, 1997: 145)

The challenge for academics remains "distinguishing the point where science ends and policy begins" (Rosenstock & Lee, 2002: 14). Researchers must keep a healthy distance from the politics and bureaucracy of government and they must know when evidence-based policy and planning is not the correct answer. In cases where uncertainty exceeds evidence then a traditional opinion-based policy process may be preferred.

3 METHODOLOGY

The motivation for this dissertation comes from the growing international reputation that the British Columbia marijuana industry has been enjoying for the past fifteen years. Arguably, for both the province and Canada as a whole, the effects of this attention could extend to damaged economic and political relations with not only our neighbours to the south, but more globally as well. At a more local level, given the assumed scale of marijuana cultivation, and its penetration into the social fabric of life on Canada's West coast, one might expect to see a significant increase in the activity of criminal organizations. While the popular media has given wide attention to the *pot* industry, research in the area of marijuana grow operations is markedly deficient. This all leads to the primary question of this research, which is: What is the scope and nature of the marijuana industry in British Columbia, and what should be done about it? It is not possible to explore all policy options in this dissertation; therefore, the focus is on assessing the impact of strategic responses guided by intelligence led policing. Specifically, this research examines two of the more promising policy implementations – green teams targeting marijuana production facilities, and an analysis of organized crime networks involved in the drug production.

This primary question can be broken down to several research questions and sub-questions:

1. What are the characteristics of the incidents of marijuana production that come to the attention of police in British Columbia?
2. What are the characteristics of the suspects of founded marijuana grow operations?
3. What is the criminal justice system response to marijuana cultivation in B.C.?
4. Are targeted police tactical teams (green teams) an effective policy response to marijuana production?
5. What is the nature of organized crime involved in marijuana grow operations?

The methodologies used to address the research questions are described in three sections: data collection methodology, spatial analysis methodology, and social network analysis methodology. As mentioned previously, because this dissertation involves several different methodologies this chapter will illustrate the general methodology used to collect data for this study. Chapters five and six outline the specific data collection and methodology for the spatial analysis and network analysis portion of this research, respectively.

3.1 Data Collection Methodology

Four different sources of data were used in this dissertation: marijuana cultivation file data, Surrey Fire Service data, criminal associate data, and data police grow operation policy choices. Refer to the Appendix for a summary of the data collection methods for each data source.

The general nature of police data and the specific information collected from the grow operation files is rarely complete. It is this incompleteness that presents the largest hurdle for this research. The following sections, detailing the methodologies for the spatial and network analysis, attempt to work with data that are traditionally incomplete in police files.

3.2 Spatial Analysis Methodology

To analyze the effectiveness of specialized police tactical units known as green teams and explore the geographic space of organized criminal networks involved in marijuana growing operations, spatial analysis and the use of geographic information systems is necessary. The specific methodology used in chapters five and six will be discussed in those chapters; however, the general description of Geographic Information Systems is reviewed below.

3.2.1 Geographic Information Systems (GIS)

Various definitions are available for what a GIS is and what the overall objectives of it might be (see Vann, 2001, for examples regarding GIS and crime) but generally, a GIS is a database that holds spatially referenced data, and allows users to query, analyze, and display these data (Burrough, 1998). Such a definition is to be distinguished from Information Management Systems (IMSs), which do not require spatially referencing. Spatial referencing refers to the process of linking spatial locations to each data element within the database, where exact or relative information regarding other data elements can be empirically determined. Locations must be defined on a coordinate plane (x, y),

and not simply listed as an attribute of a given object. For example, it is not enough to note that a particular incident in a police file occurred at a given address (100 E Hastings Street), but that the event is tied to a geographical space that is precisely 50 m 270 degrees E of 50 E Hastings Street. Geographically referenced data also have the advantage of inheritance in many cases; for example, if a point is located within police atom A10, and A10 is part of the known boundaries of the City of Vancouver, we know by definition, that the location in question is also within the city of Vancouver. An understanding of what the basic unit—or building blocks—of GISs is important in understanding the various types of spatial analysis that will be used in this dissertation.

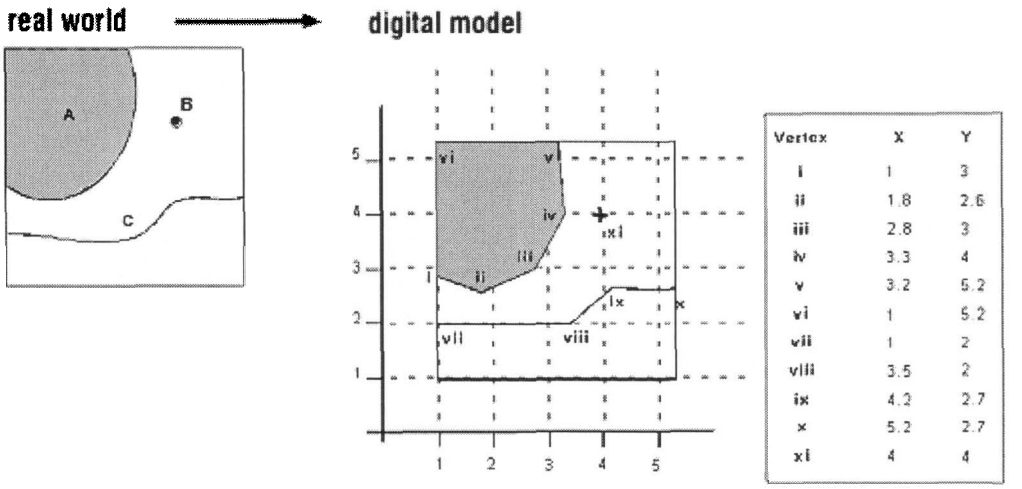
At its most basic level, GIS data can be represented in two different ways.[5] First, a field represents a given space based on some measurable, continuous variable, such as annual rainfall. This form of representation is favoured among the natural sciences, where the entities being mapped are often describable using "true" ratio levels of measurement. Surface elevation, forest density, and so on, are well captured by field models of representation. The second form of representation is the entity (or object) model. Entity maps are common where you have clearly defined categories of phenomena to represent spatially. Entities are common in the social sciences, where regions, planning areas, or qualitative zones are important in classifying relations between entities. Planning districts are properly thought of as qualitative as they are arbitrarily assigned in many cases. The most common social data: census, city planning, and land use data

[5] This section is based largely upon materials from the website of Prof. Nadine Schuurman, a specialist GIS database ontologies, see URL Reference: http://www.sfu.ca/gis/geog_x55/web355/icons/1_lec_Representing%20the%20Earth.pdf

are often coded by legally defined zones. In this sense, because the base units to be mapped are clearly defined, and tend not to blend in and out of existence, an entity model is often used in the social sciences—although arguments could be made for 'fuzzy' boundaries.

Fields and entities are often associated with two classes of *primitives*, the smallest units, or data elements, within a given GIS. There are two essential classes of primitive: (1) vector and (2) raster representations. Figure 3.1 represents a slice of 'the real world' and its subsequent rendering in a vector data model.[6] Entities A, B, and C are described in the vector system using a series of arcs which are composed of vertices.

Figure 3.1: Vector Data Model

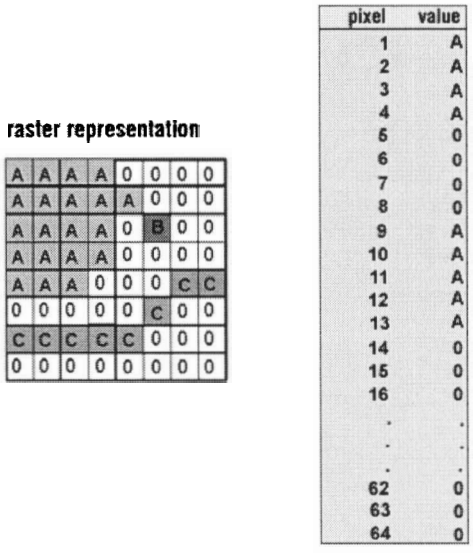


Vertex	X	Y
i	1	3
ii	1.8	2.6
iii	2.8	3
iv	3.3	4
v	3.2	5.2
vi	1	5.2
vii	1	2
viii	3.5	2
ix	4.2	2.7
x	5.2	2.7
xi	4	4

[6] http://www.sli.unimelb.edu.au/gisweb/GISModule/GIST_Vector.htm#ad

Vector representations are most often linked to entity, or object model discussed above, while raster is linked to the field model. Figure 3.2 depicts the raster data model for the same 'reality' as seen in Figure 3.1.[7]

Figure 3.2: Raster Data Representation



Each pixel in Figure 3.2 possess a value, starting in this field from the top left position, and ranging across to the right until the end of the field, then dropping to the next row where the process continues until all pixels are resolved to a value. Raster data are often derived from satellite (remote sensed) imagery, where each pixel is evaluated and assigned values based on shades and light within the picture. This dissertation uses vector data, in the form of street addresses. The only raster data that will be used are orthographic photographs of certain locations where grow operations appear to cluster. An orthographic photograph is a digital image where distortion has been removed and images are georeferenced so that they can be overlayed on the vector data (street

[7] http://www.sli.unimelb.edu.au/gisweb/GISModule/GIST_Raster.htm#rasterisation

addresses). In addition to the descriptive and spatial analysis methodologies used in this research, social network analysis is utilized to investigate the involvement of criminal organizations in the marijuana grow operation industry.

3.3 Social Network Analysis Methodology

Social network analysis techniques are used to explore organized criminal networks involved in marijuana growing operations. The specific methodology used in chapters six will be discussed in that chapter; however, the general description of social network analysis is reviewed below.

Social network analysis involves studying the associations between interdependent individuals, or other variables, recognizing that each actor is influenced by his or her associates. This is different from classic quantitative methods in social science because the unit of analysis is not an individual, but rather a group of individuals and the connections between them. "Network analysis often relies on artifacts, direct observation, laboratory experiments, and documents as data sources -- and usually there are no plausible ways of identifying populations and drawing samples by probability methods" (Hanneman, 2001). Network analysis cannot rely on independent random sampling, or popular statistical techniques based on independent samples such as multivariate regression, because most populations in network analysis are dependent on one another by definition. Network analysts often choose to work out precise probability distributions using simulation instead of using inferential statistics.

Over the past decade, there has been a rise in the usage of social network analysis in social science research. One reason for this growth is the increasing complexity of social problems due to globalization and technology advancements. Another reason is the wide availability of new network analysis software and manuals.

In order to describe social network analysis, there are a number of concepts that must be defined. Some of these concepts are intuitive and easily understood; others require examples to elucidate their meaning. Another complication encountered in describing network analysis is the number of terms that are used synonymously. There are several instances where three or four terms are used to describe the same concept. For the sake of clarity and brevity, social network terminology and methodology are combined in this chapter. This section begins with an introduction to simple concepts, and quickly leads into more complex concepts and methodology.

The concepts of nodes, edges and paths are arguably the most central to network analysis. Social network analysis uses the term *nodes* to denote subjects or sample elements. Nodes are not independent from one another, as subjects or sample elements may be, regardless of how they are sampled. *Edges* are the relationships or ties between nodes. Edges/connections between nodes can be directed or undirected. Directed connections allow for information to travel in one direction, rather than freely between both nodes. Undirected connections involve symmetry where information (or whatever variable you are interested in) is assumed to travel freely between both nodes. Connections can

also be weighted or unweighted. In weighted edges, the connection includes a measure of strength (Berkowitz, 1982; Hanneman, 2001; Wassermann & Faust, 1994). *Paths* are defined as "a sequence of distinct, connected nodes in a network", and the geodesic between nodes is the shortest path between them (Lovejoy & Loch, 2003: 334). Path length is one of the most important concepts in social network analysis, and the average path length, or characteristic path length, is taken to represent closeness in a network (Lovejoy & Loch, 2003). This path length is termed a geodesic distance and does not have a geographic orientation. Social network analysis rarely involves random sampling from a specific population, in a classic sense. Since the nodes are not independent from one another, the *population* is usually defined as all nodes belonging to a specific organization or institution. Having defined some basic concepts, the multi-modal nature of network analysis is now described.

Networks can exist over different levels or modes. If network analysis is being conducted on more than one mode at a time it is known as multi-modal. For example, when examining organized crime's involvement with marijuana growing operations, a network analysis can occur on several different modes. One mode exists at the individual level, where individuals within an organization are connected by a measure of how well they know each other; another mode exists where different criminal organizations are connected by dollar exchange; yet another mode exists where nations in the drug trade are connected by record of drug shipments. While most networks function as multi-modal, very few network analyses occur over one or two modes at a time (Berkowitz, 1982;

Hanneman, 2001; Wassermann & Faust, 1994). The difficulty of exploring many multi-nodal models lies in algorithm complexity and the visual clarity.

There are four different methods for data collection in network analysis. *Full network methods* involve collecting data from every member of a population. Since collecting data from every member of a population might not be possible, due to cost or data availability, other methods are necessary. *Snowball methods* involve speaking to a few central actors and then speaking to their associates, and repeating the process until the researcher decides to stop. The primary problem with snowball sampling is that associates who are not connected, or isolates, are not captured in the network analysis.

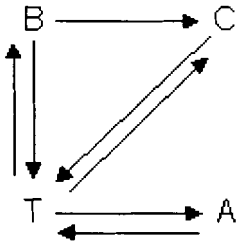
Another methodology of network analysis involves ego-centric networks. *Ego-centric networks* require analyzing the networks of a group of egos within the population and their connections to one another. An *ego* is the primary node the connections are based one and an *alter* is the node the ego is connected to. This method is particularly useful in large or difficult to access populations. The final type of methodology is *ego-centric networks with alter connections.* In this methodology, information is not only collected from central network egos, but also their *alters* and the connections among these associates (Hanneman, 2001). This research uses ego-centric networks because all of the data are collected from police files and information is only available on people of interest to the police. In other words, non-criminal associations are not included in the data. This issue leads naturally into a discussion of multiple relations.

Network connections between nodes can exist based on a number of relationships. For instance, a member of a criminal organization may have associates based on illegitimate business, legitimate business, family, law enforcement, and from countless other areas. As a criminologist studying networks of criminal organizations, one would be most interested in associates from illegitimate business; however, legitimate business, family and even law enforcement associates/alters may provide interesting connections in the network. Theory and data availability guided which relations to consider in this network analysis. The literature on criminal networks (see chapter 6) and the data available in the police files lead the author to collect information on all associates included in the police data; those being primarily criminal associates, however, familial associates were also present in the files.

A social network analysis uses two tools to represent networks of nodes: graphs and matrices. While a basic description of both graphs and matrices is presented, an in-depth discussion into the sub-fields of graph theory and matrix algebra is beyond the scope of this dissertation. Visualization is very important in the analysis and presentation of social networks. Both the graph and matrix present networks visually, but graphs tend to be easier to interpret. Moreno's pioneering work on sociometry (1953) relies heavily on the graphical representation of sociometric data (Brandes, Raab, & Wagner, 2001). Graphs, or socio-grams as they are often termed in sociology, use a point to depict the individual/node in the network and a line to represent the connection between the

two nodes. Figure 3.3 illustrates a very simple directed network graph, where the connections between each node are not necessarily reciprocal.

Figure 3.3: Simple directed graph (Hanneman, 2001)



If a network is very large and dense (many connections) a graph may become too visually complicated to interpret. A matrix can depict very large networks in a very organized tabular fashion. Katz has argued for representing networks by matrices in the place of sociograms because of their increased ability to manage complex networks (Brandes et al., 2001; Katz, 1953). Figure 3.4 depicts a simple 4x4 matrix of the graph from figure 3.2. Matrices are described by number of rows x number of columns, with the label row and column excluded.

Table 3.1: 4 x 4 matrix (adapted from (Hanneman, 2001)

	B	C	T	A
B		1	1	0
C	0		1	0
T	1	1		1

A	0	0	1	

In Table 3.1, each association is measured using a 1 (connection present) or a 0 (connection not present). This measure of association is termed binary, but there are more complex methods to measure the association of nodes in a network.

There are different scales of measuring associations in network analysis: binary measures; multiple-category nominal measures; full-rank ordinal measures; and interval measures (Hanneman, 2001). *Binary measures* use a 0 to denote the absence of a relationship and a 1 to indicate the presence of a relationship. Binary measurement is common in network analysis, but it does not allow for a great deal of complexity in relationships. *Multiple-category nominal measures* of relations involve scoring relations based on the type of association present. In criminal organizations a relationship could be coded as illegitimate business/criminal, legitimate business, family, or friend; however, only one type of relationship can exist. An alter cannot be coded as a family and criminal associate. This type of coding is not always sufficient in explaining a network. *Full-rank ordinal measures* of relations entail ranking nodes with a strength of association measure. An example of a full-rank ordinal measure of relations is asking subjects to rank their associates on some measure (i.e. strength of friendship, loyalty). There can be no overlap of scores – only one person can be your ranked #1 in friendship, only one as #2 in friendship, and so forth. However, this ranking is still ordinal in level of measurement, the distance between friend one and friend two is not quantitatively the same as the distance between friend 11 and 12. *Interval measures* of relations involve quantitative ranking of

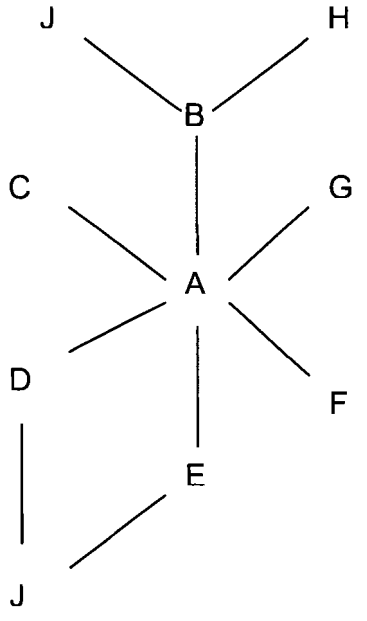
association where the differences between number one and two is the same as the distance between 11 and 12. Using the criminal organization example, an interval measure of relation might ask the subject how many times they have contact with each association over a specific amount of time. This would result in an interval level scoring of association. This dissertation is limited to multiple-category nominal measures due to the nature of the information present in the police files. Regardless of the measure of association that is used, connectedness is a very important concept in network analysis.

Some actors are very connected and others are not. There are many variables that may be influenced by connectedness, including influence and authority. On a macro-level, the density of connections in a population can influence stability and adaptability of the group. Closeness of connections is also significant in understanding networks. If actors have close connections, in other words, if their communication is direct and easily accessible, the network is likely to be less diffuse and homogenous, and have more solidarity (Berkowitz, 1982; Hanneman, 2001; Wassermann & Faust, 1994). As the group gets larger, the density of ties usually reduces. On a micro-level, an individual's influence and authority are impacted by their power and centrality within a network.

Centrality and power are concepts very important to network analysis in criminology. Network analysis has taught us much about power in social settings. Most importantly, it emphasizes that power is relational – one node's power is another node's dependence (Hanneman, 2001). Connectedness also contributes to power in social relationships. If a network has high density, then

more power can be exuded on the network as a whole. Power in a criminal network is associated with position. The concept of centrality is particularly important when discussing position and power in a criminal network (Costenbader & Valente, 2003; Hanneman, 2001; Ruhnau, 2000). There are three different categories of centrality: degree centrality, closeness centrality and betweenness centrality. *Degree centrality* measures the amount of connections each node has within the network. The node with the most connections has highest degree centrality. In Figure 3.4, node A has the highest degree centrality, with connections to every node in the network, and has by definition the most power in the network. *Closeness centrality* focuses on the geodesic distance of the connections between nodes. It is apparent that node A (Figure 3.4) has the highest closeness centrality, once again exhibiting the most power in the network. *Betweenness centrality* measures the number of times a node is between another node's connections. In the context of information transfer, the individual who has to rely on the least amount of other individuals to pass information through has the highest betweenness centrality and the highest degree of power. In Figure 3.4, node A has the highest betweenness centrality.

Figure 3.4: Star network



Both the micro and macro levels of networks and their associations have been discussed. The meso-level of network analysis involves cliques, subgroups and components.

Network analysts assert that networks are made up of smaller subgroups such as cliques, n-cliques, n-clans, and k-plexes (Hanneman, 2001). A clique is a subset of actors who are more closely tied to each other than to others in the network (Hanneman, 2001). The questions that we can answer by examining subgroups are:

- How separate are the sub-graphs (do they overlap and share members, or do they divide or factionalize the network)?
- How large are the connected sub-graphs? Are there a few big groups, or a larger number of small groups?
- Are there particular actors that appear to play network roles? For example, act as nodes that connect the graph, or who are isolated from groups? (Hanneman, 2001)

The traditional definition of a clique, all members maximally connected, does not always happen. N-cliques are defined as subgroups where the members are connected by a distance greater than one; in other words, the members are friends of a friend (Berkowitz, 1982; Hanneman, 2001; Wassermann & Faust, 1994). N-clans, K-plexes and K-cores are cliques, like N-cliques, where the connection distance and density of connections still conform to a subgroup, but are not maximally connected like a traditional clique. Components are parts of networks that are broken off from other elements of the network. These breaks occur at cutpoints and form blocks. Cutpoints are the node/actor who, if removed, would separate the network into subgroups. These subgroups are generally known as blocks. The next section describes two concepts important to the network analysis of organized crime: social position and equivalence.

The concepts of social position and equivalence are similar to cliques and blocks, but allow us to group nodes/individuals based on function rather than on position and connections within a network. Equivalence is a tool used to define social positions (Hanneman, 2001; Marx & Masuch, 2003). According to Wasserman and Faust, "subsets of actors with similar roles are equivalent, and occupy the same network position" (Wassermann & Faust, 1994: 465). In other words, social positions are nodes based on categories of structures. These categories can be structurally equivalent or regularly equivalent. Structural equivalence is concrete, in that two structurally equivalent nodes are identical to one another. Regular equivalence is more abstract, where nodes occupy the same role. For example, marijuana cultivators grow marijuana: they do not

always grow marijuana in the same exact location, but they still occupy the social position of "marijuana grower", and thus they have regular equivalence. Network analysis software developed over the past decade has dramatically increased the complexity of network analysis and the analysis conducted in this research would not have been possible without the use of this software.

3.3.1 Software

In the past, one of the most inherent difficulties with network analysis was laying out information on an abstract background (since very few networks have a geographic background) and making it readable (Brandes et al., 2001). In the past decade and a half, software packages have emerged that make data analysis and presentation far more widely accessible. The major network software packages are UCINet, GraphPlot, Graphviz, Pajek, Multinet, and Krackplot, although there are others. This dissertation uses UCINet, from the University of California, Irvine. UCINet was developed by three pioneers of computerized network analysis, Borgatti, Everett and Freeman. This software contains many network analytic routines such as:

> centrality measures; dyadic cohesion measures; positional analysis algorithms; clique finders; stochastic dyad models; network hypothesis testing procedures (including QAP matrix correlation/regression and categorical and continuous attribute autocorrelation tests); plus general statistical and multi-variate analysis tools such as multidimensional scaling; correspondence analysis; factor analysis; cluster analysis; multiple regression; and a host of data management and transformation tools ranging from graph-theoretic procedures to a full-featured matrix algebra language. (Borgatti, Everett, & Freeman, 2002)

Figures 3.5 through 3.7 illustrate different ways of presenting the same data using network analysis software.

Figure 3.5: Simple UCINet Network Visual Representation (Brandes et al., 2001:8)

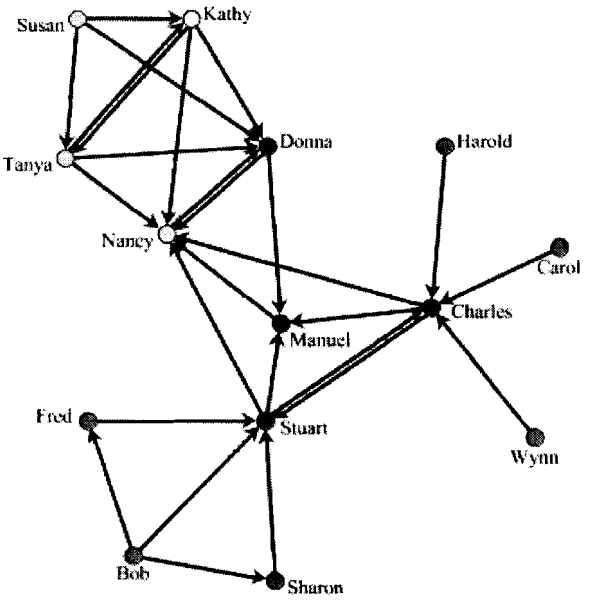


Figure 3.6 provides a very readable visual, but its explanation is flawed. The visual does not relay the hierarchy, or status scores, of the actors.

Figure 3.6: Hierarchical UCINet Network Visual Representation (Brandes et al., 2001: 9)

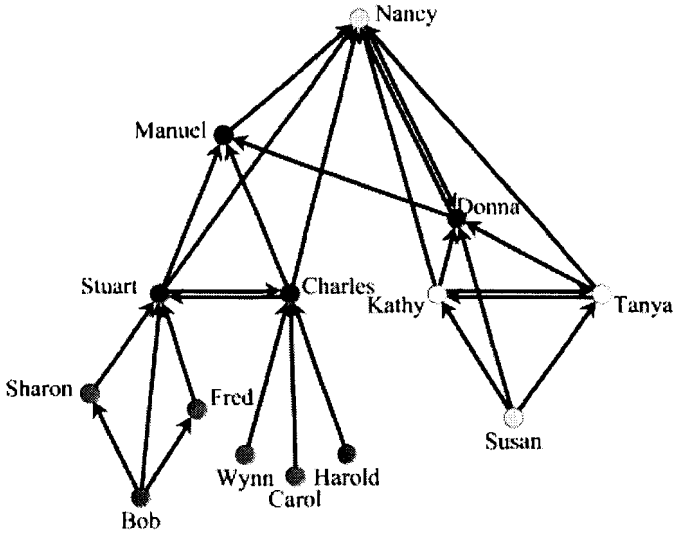


Figure 3.7 is better because the hierarchy of the network is conveyed.

Figure 3.7: Hierarchical (with levels) UCINet Network Visual Representation (Brandes et al., 2001: 10)

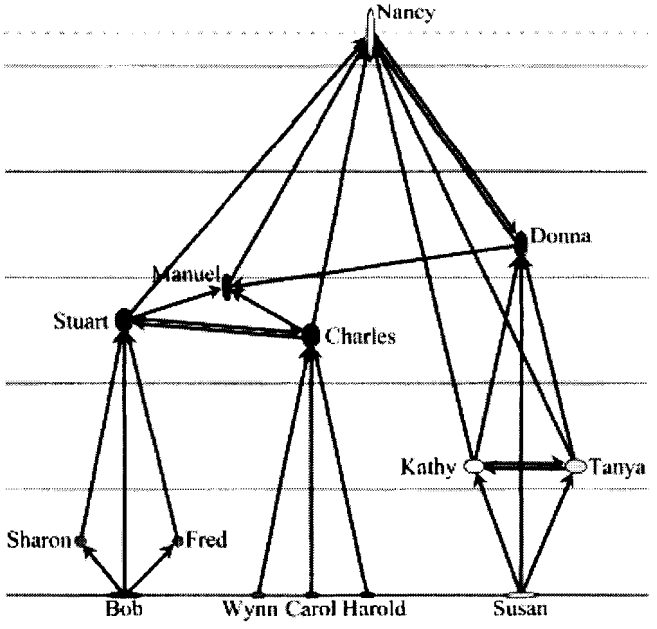


Figure 3.7 not only conveys a hierarchy, but the horizontal lines also denote a quantitative element to the levels of hierarchy. In this case, each horizontal line represents a five percent rise in the status index. These graphs illustrate how the use of network analysis software can assist in visualization of network data.

3.3.2 Data Availability

The data available to researchers in the area of organized crime are primarily from police records and certain intelligence information. The police files include information on co-offenders, criminal records, demographics, home address (if known), and automobile information. Intelligence files held by specific drug sections hold more in-depth information, including known associates and group membership. In this dissertation, I did not interview police officers for more information on specific criminal networks. This information would prove very interesting, but it does not provide exhaustive information about criminal

networks. Ideally, the author would have been able to interview the individuals involved in criminal organizations connected to grow ops, but this is not possible due to research ethics. Without asking group members who they know and conduct business with, an absolutely complete network analysis is impossible. However, Swedish statistician, Ove Frank (2001), has used network techniques with police file data and found some interesting results on co-offending networks.

Frank suggests that statistical network models can estimate co-offending patterns and the structure of co-offending networks. Offence data can be used to identify related crimes and related co-offenders. For instance, grow operation A may have three suspects/co-offenders, one of these suspects may be involved in grow operation B and C. Grow operation A, B and C would be considered related crimes due to the co-offender link. Consider M to be the amount of grow operations in a specific geographic area for a specific period of time, say BC for 2001, and the set of crimes would be denoted by U = (1....M). N is taken to be the total number of offenders related to these grow operations, and the set of offenders is V = (1...N). The resulting criminal activity matrix, let's call it the C matrix, would be M by N. C_{uv} is a binary measure, equal to 1 if the offender (v) is associated with the specific crime (u) and 0 if the offender is not associated with the crime, for $u \in U and v \in V$. The row and column sums of the criminal activity matrix would be $a_u = \sum_{v \in V} C_{uv}$ for $u \in U$ and $b_v = \sum_{u \in U} c_{uv}$ for $v \in V$ (Frank, 2001: 204-205). Equations a_u and b_v denote the size of crime U and the activity of offender V, respectfully. This research will combine Frank's methodology with the use of

UCINet and produce a network analysis of different criminal organizations involved in B.C.'s marijuana cultivation industry.

4 THE NATURE AND SCOPE OF MARIJUANA GROWING OPERATIONS IN BRITISH COLUMBIA[8]

Over the past decade, the nature, distribution and consequences of illicit marijuana growing operations have become a major concern among the public, the media and those involved in the criminal justice system in British Columbia (BC). Despite this concern, grow operations are often eclipsed by the related issue of marijuana possession and consumption. Notwithstanding the importance of the "legalization debate", information on the scope and hazards surrounding marijuana cultivation is critical if Canada is to make an informed decision on marijuana drug policy.

This chapter describes marijuana growing operations in British Columbia. Incident related variables examined include: scope of problem (number of grow operations by jurisdiction and region); source of information; type of operation; size of operation (number of plants and lights); and hazards present. Suspect related variables include: demographics (ethnicity, age, gender); and criminal history. Criminal justice system response variables include: type of police investigation; charge rates; stay rates; and type of sentences. The research questions answered in this section are:

1. What are the characteristics of the incidents of marijuana production that come to the attention of police in British Columbia?

[8] This chapter is adapted from the research report "Marijuana Growing Operations in British Columbia Revisited: 1997-2003" by Plecas, Malm and Kinney (2005).

a. Is there a difference between urban and rural grow operations?

2. What are the characteristics of the suspects of founded marijuana grow operations?
3. What is the criminal justice system response to marijuana cultivation in B.C.?

The data collection methodology for this chapter was detailed in the previous chapter. Refer to Plecas et al. (2005) for the data collection instruments.

According to Statistics Canada[9], 70% of all drug offences in 2003 involved cannabis, 14% of all cannabis offences were for cultivation, and the majority of the production offences took place in BC (See Table 4.1). Almost 40% of all marijuana cultivation incidents reported to Statistics Canada occurred in British Columbia and the rate of cultivation incidents in BC (79 per 100,000 population) is almost three times the national rate (27 per 100,000 population).

[9] Canadian Centre for Justice Statistics (2004). *Canadian Crime Statistics 2003.* Ottawa: Statistics Canada, December 2004, Catalogue no. 85-205-XIE.

Table 4.1: Marijuana Cultivation Incidents by Province, 2003

Province	Frequency	Percentage of Total	Rate/ 100,000 population
BC	3274	38.75 %	79
NB	342	4.19 %	46
PQ	2939	34.79 %	39
TERR	15	0.18 %	39
NS	328	3.88 %	35
PEI	35	0.41 %	25
SK	132	1.56%	13
MB	142	1.68 %	12
NFLD	44	0.52 %	8
ON	990	11.72 %	8
AB	208	2.48 %	7
CANADA	8449	100.00 %	27

Source: CCJS; Canadian Crime Statistics 2004 Catalogue No: 85-205-XIE

4.1 Incidents of Marijuana Grow Operations in BC

4.1.1 Suspected Cases of Marijuana Cultivation

Marijuana growing operations coming to the attention of the police dramatically increased between the years 1997 through 2000; however, from 2000 through 2003, the number of grow ops seems to have hit a plateau (see figure 4.1). It is important to note that there are regional differences in this trend. In areas of concentrated population, particularly the Lower Mainland and

Vancouver Island, the number of grow ops increased from 1997 through 2000 and have slightly decreased since 2000. Simultaneously, the number of cases in more rural areas of British Columbia has increased (see Table 4.2 and 4.3). The reason for this shift to rural centres might be the result of the need for larger properties to increase production and minimize detection.

Figure 4.1: Number of Marijuana Grow Operations Which Came to the Attention of Police Agencies in British Columbia between January, 1 1997 and December 31, 2003

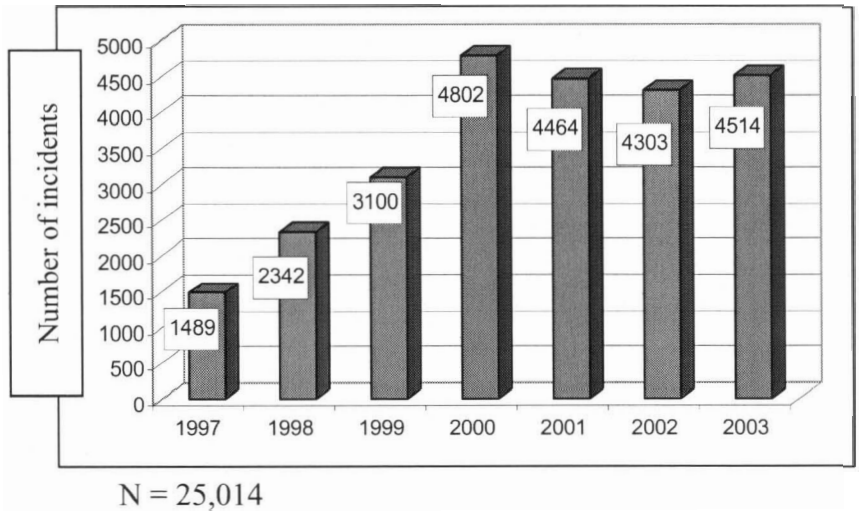


Table 4.2 shows the frequency of marijuana cultivation cases in the eight development regions of the province: Mainland/Southwest, Vancouver Island/Coast, Thompson/Okanagan, Cariboo, Kootenay, North Coast, Nechako, and the Northeast.

Table 4.2: Cases That Came to the Attention of Police Between January 1, 1997 and December 31, 2003 (by Development Region and Regional District)

*Development Region / Regional District**	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Increase since 1997*
Greater Vancouver	548	916	1299	2497	1787	1719	1929	252%
Fraser Valley	177	234	306	494	375	485	408	131%
Squamish-Lillooet	13	18	22	33	44	48	42	223%
Mainland/Southwest Overall	**738**	**1168**	**1627**	**3024**	**2206**	**1619**	**3012**	**222%**
Comox-Strathcona	84	131	173	212	224	211	198	136%
Sunshine Coast	20	59	52	50	78	47	49	145%
Mount Waddington	6	18	15	15	12	20	10	67%
Cowichan Valley	56	108	130	139	149	145	98	75%
Nanaimo	122	156	218	259	252	207	197	61%
Powell River	0	16	16	19	47	42	75	100%
Alberni-Clayoquot	21	21	25	35	50	63	70	233%
Capital	111	111	150	143	139	125	184	66%
Vancouver Is/ Coast Overall	**420**	**620**	**779**	**872**	**951**	**860**	**881**	**110%**
Northern Okanagan	30	53	50	91	126	99	95	217%
Thompson-Nicola	49	109	104	139	169	169	148	202%
Central Okanagan	40	63	90	96	322	281	260	550%
Okanagan-Similkameen	34	42	51	70	85	84	87	156%
Columbia-Shuswap	26	29	39	39	74	48	70	169%
Thompson/Okanagan Overall	**179**	**296**	**334**	**435**	**776**	**681**	**660**	**269%**
Fraser-Fort George	27	42	64	155	129	98	195	622%
Cariboo	25	57	50	92	54	42	34	36%
Cariboo Overall	**52**	**99**	**114**	**247**	**183**	**140**	**229**	**340%**
Central Kootenay	36	57	114	98	161	163	159	342%
East Kootenay	14	21	23	34	45	62	51	264%
Kootenay Boundary	13	43	52	26	39	45	49	277%
Kootenay Overall	**63**	**121**	**189**	**158**	**245**	**270**	**259**	**311%**
Kitimat-Stikine	10	13	12	28	42	18	46	360%
Central Coast	1	2	2	2	2	7	4	300%
Skeena-Qn. Charlotte	7	7	10	6	5	9	10	43%
North Coast Overall	**18**	**22**	**24**	**36**	**49**	**34**	**60**	**233%**
Bulkley-Nechako	14	8	13	21	28	29	22	57%
Stikine (region)	1	1	2	0	0	1	1	0%
Nechako Overall	**15**	**9**	**15**	**21**	**28**	**30**	**23**	**53%**
Peace River	4	6	12	7	26	36	23	475%
Northern Rockies	0	1	6	2	0	0	0	0%
Northeast Overall	**4**	**7**	**18**	**9**	**26**	**36**	**23**	**475%**
Province Overall	**1489**	**2342**	**3100**	**4802**	**4464**	**4303**	**4514**	**203%**

* Source of population statistics: Population Estimates 1996-2004, BC Stats, Ministry of Management Services, Government of British Columbia. Accessed January 5, 2005 from www.bcstats.gov.bc.ca/data/pop/pop/mun/Mun9604a.htm

Tables 4.3 and 4.4 control for population to allow for comparison between regions and regional districts. Figures 4.3 and 4.4 compare the percentage variance from the provincial rate in each regional district in 2000 and 2003 in order to illustrate the changes occurring in certain districts since 2000. These changes will be further explored in Chapter 5, when the impact of specialized tactical teams (green teams) is assessed.

Table 4.3: Number and Rate Per 1,000 Population of Marijuana Cultivation Cases Known to the Police in 2003 by Development Region /Regional District.

Development Regions and Regional Districts	*Population 2003**	*Total no. of cases in 2003**	*Rate per 1,000 population in 2003**	*No. of cases in 2003 as a percentage of total no. of cases in BC*	*Percentage of the total provincial population*
Greater Vancouver	2,113,699	1929	.91	42.7	50.9%
Fraser Valley	253,986	408	1.61	9.0	6.1%
Squamish-Lillooet	35,761	42	1.17	0.9	0.9 %
Mainland/Southwest Overall	**2,403,444**	**2379**	**0.98**	**52.6**	**57.9 %**
Nanaimo	136,122	197	1.45	4.4	2.5 %
Comox-Strathcona	101,882	198	1.94	4.4	2.5 %
Capital	344,299	184	0.53	4.1	8.3 %
Cowichan Valley	76,457	98	1.28	2.2	1.8 %
Sunshine Coast	27,388	49	1.79	1.1	0.7 %
Alberni-Clayoquot	31,813	70	2.20	1.6	0.8 %
Powell River	20,708	75	3.62	1.7	0.5 %
Mount Waddington	13,502	10	.74	0.2	0.3 %
Vancouver Isl. /Coast Overall	**752,171**	**881**	**1.17**	**19.7**	**18.1 %**
Thompson-Nicola	125,746	148	1.18	3.3	3.0 %
Central Okanagan	160,491	260	1.62	5.8	3.9 %
Northern Okanagan	77,854	95	1.22	2.1	1.9 %
Okanagan-Similkameen	81,044	87	1.07	1.9	2.0 %
Columbia-Shuswap	51,234	70	1.37	1.6	1.2 %
Thompson/Okanagan Overall	**496,369**	**660**	**1.33**	**14.7**	**12.0 %**
Fraser-Fort George	100,523	195	1.94	4.3	2.4 %
Cariboo	68,502	34	0.49	0.8	1.6 %
Cariboo Overall	**169,025**	**229**	**1.35**	**5.1**	**4.0 %**
Central Kootenay	60,125	159	2.64	3.5	1.4 %
East Kootenay	60,060	51	0.85	1.1	1.4 %
Kootenay Boundary	33,213	49	1.48	1.1	0.8 %
Kootenay Overall	**153,398**	**259**	**1.69**	**5.7**	**3.7 %**
Kitimat-Stikine	42,479	46	1.08	1.0	1.0 %

Central Coast	3,896	4	1.03	0.1	0.1 %
\Skeena-Queen Charlotte	22,281	10	0.45	0.2	0.5 %
North Coast Overall	**68,656**	**60**	**0.87**	**1.3**	**1.7 %**
Bulkley-Nechako	42,565	22	0.52	0.5	1.0 %
Stikine (region)	1,374	1	0.73	0.0	0%
Nechako Overall	**43,939**	**23**	**0.52**	**0.5**	**1.1 %**
Peace River	59,168	23	0.39	0.5	1.4 %
Northern Rockies	6,119	0	0.00	0.0	0.1 %
Northeast Overall	**65,287**	**23**	**0.35**	**0.5**	**1.6 %**
Province Overall	**4,152,289**	**4514**	**1.09**	**100**	**100.0%**

* Source of population statistics: Population Estimates 1996-2004, BC Stats, Ministry of Management Services, Government of British Columbia. Accessed January 5,2005 from www.bcstats.gov.bc.ca/data/pop/pop/mun/Mun9604a.htm

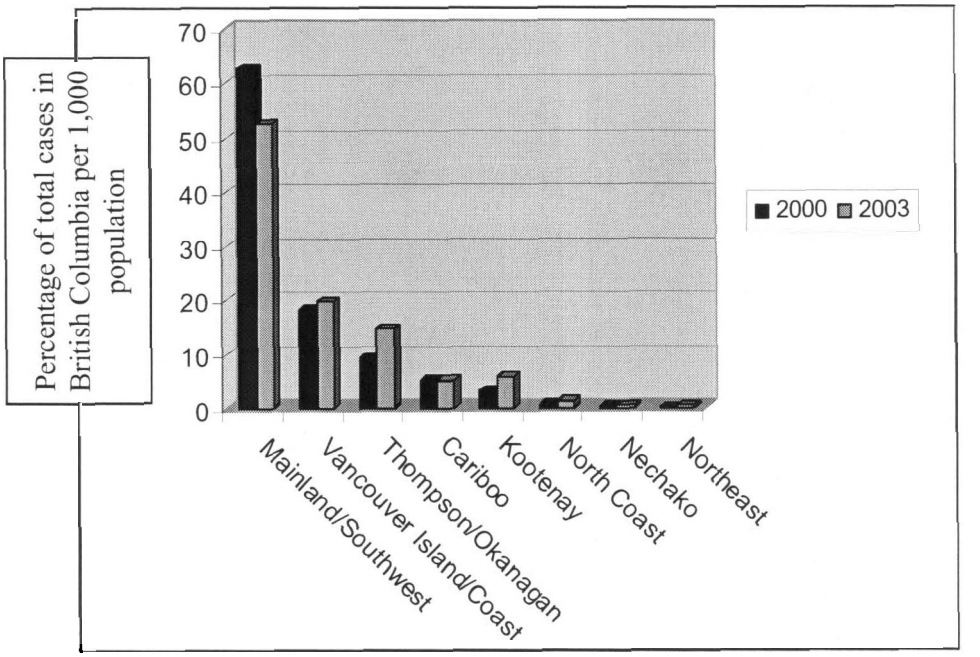
Table 4.4: Marijuana Cultivation Cases Known to the Police in 2003: Rates Per 1,000 Population in Each Development Region and Regional District of BC; Percentage and Direction of Local Rate Variance From Provincial Rate

Development Regions and Regional Districts	*Rate per 1,000 population in 2003*	*Percentage variance from provincial rate of 1.09 per 1,000*
Greater Vancouver	0.91	-17
Fraser Valley	1.61	+48
Squamish-Lillooet	1.17	+7
Mainland/Southwest Overall	**0.98**	**-10**
Nanaimo	1.45	+33
Comox-Strathcona	1.94	+78
Capital	0.53	-51
Cowichan Valley	1.28	+17
Sunshine Coast	1.79	+64
Alberni-Clayoquot	2.20	+102
Powell River	3.62	+232
Mount Waddington	0.74	-32
Vancouver Island/Coast Overall	**1.17**	**+7**
Thompson-Nicola	1.18	+8
Central Okanagan	1.62	+49
Northern Okanagan	1.22	+12
Okanagan-Similkameen	1.07	-2
Columbia-Shuswap	1.37	+26
Thompson/Okanagan Overall	**1.33**	**+22**
Fraser-Fort George	1.94	+78
Cariboo	0.49	-55
Cariboo Overall	**1.35**	**+24**
Central Kootenay	2.64	+142
East Kootenay	0.85	-22
Kootenay Boundary	1.48	+36
Kootenay Overall	**1.69**	**+55**
Kitimat-Stikine	1.08	-1
Central Coast	1.03	-6

Skeena-Qn. Charlotte	0.45	-59
North Coast Overall	**0.87**	**-20**
Bulkley-Nechako	0.52	-52
Stikine (region)	0.73	-33
Nechako Overall	**0.52**	**-52**
Peace River	0.39	-64
Northern Rockies	0.00	-100
Northeast Overall	**0.35**	**-68**

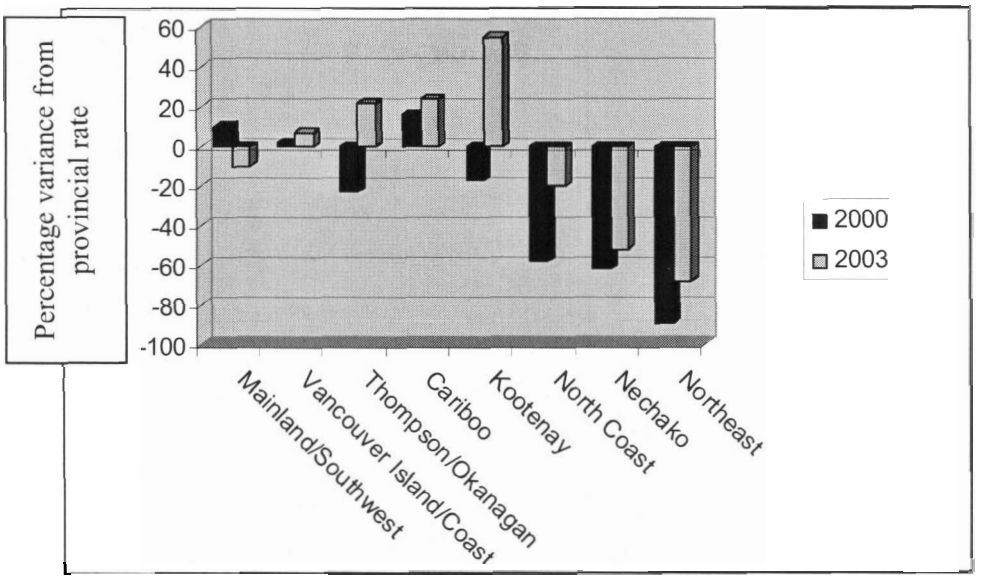
* Source of population statistics: Population Estimates 1996-2004, BC Stats, Ministry of Management Services, Government of British Columbia. Accessed January 5,2005 from www.bcstats.gov.bc.ca/data/pop/pop/mun/Mun9604a.htm

Figure 4.2: Percentage of total cases in BC per 1,000 population in each development district in 2000 and 2003



* Figure adapted from: Plecas et. Al. (2005)

Figure 4.3: Development District % Variance from Provincial Rate in 2000 and 2003



* Figure adapted from: Plecas et. Al. (2005)

Over 70 percent of all marijuana grow ops can be found in the Lower Mainland and Capital District. Figure 4.2 and Figure 4.3 show that since 2000 grow op cases have decreased in the Lower Mainland and increased in Vancouver Island/Coast, Thompson/Okanagan and Kootenay regions. The rest of the jurisdictions are relatively stable from 2000 to 2003.

Table 4.5 presents the ten jurisdictions that account for over 50% of all cases that came to the attention of the police for the year 2003. Each of these jurisdictions have over 150% increases in the incidents from 1997, and the average number of cases of marijuana cultivation in 2003 was 245. The largest increase over the seven year period is in Prince George and Coquitlam, each of which increased over 600%.

Table 4.5: Jurisdictions with Highest Volume of Marijuana Cultivation Files (2003)

RCMP Detachment/ Police Department	*Number of cases of marijuana cultivation in 2003*	*Percentage increase over the seven-year period*	*Number of files as a percentage of all files opened in BC in 2003*
Surrey	441	385 %	9.8 %
Vancouver	335	162 %	7.4 %
Coquitlam	297	624 %	6.6 %
Kelowna	260	550 %	5.8 %
Burnaby	218	169 %	4.8 %
Chilliwack	204	214 %	4.5%
Prince George	189	722 %	4.2 %
Richmond	180	339 %	4.0 %
Langley	170	170 %	3.8 %
Ridge Meadows	152	375 %	3.4 %
Average	**245**	**304 %**	**54 %**

* Table adapted from: Plecas et. Al. (2005)

Table 4.6 shows the top ten jurisdictions and how they vary from the provincial rate of marijuana growing operations that came to the attention of the police in 2003. Interestingly, the rural locations show a larger variation from the provincial average than the urban locations in the top ten. Vancouver is now 47% below the provincial rate (contrast this with 2000 when Vancouver was 1% above the provincial rate). The jurisdictions of Delta, Nanaimo and Abbotsford were in the top ten jurisdictions in 2000 and have dropped off the list for 2003. Each of these jurisdictions have a tactical unit specializing in investigating marijuana grow ops. The impact of these units will be investigated further in Chapter 5.

Table 4.6: Jurisdictions in British Columbia With Highest Volume of Marijuana Cultivation Cases in 2003

RCMP Detachment or Police Department	*Number of cases in 2003*	*Population**	*Rate per 1,000 population*	*Percentage* variance from provincial rate (1.09)*
Surrey	441	378,578	1.16	+ 6%
Vancouver	335	577,962	0.58	- 47%
Coquitlam	297	175,496	1.69	+ 55%
Kelowna[10]	260	110,167	2.36	+ 117%
Burnaby	218	202,852	1.07	- 2%
Chilliwack[11]	204	80,719	2.53	+ 132%
Prince George	189	76,597	2.47	+ 127%
Richmond	180	172,032	1.04	- 5%
Langley	170	117,366	1.45	+ 33%
Ridge Meadows[12]	152	84,933	1.79	+ 64%

* Table adapted from: Plecas et. Al. (2005)

4.1.2 Sources of Information

This section provides information on the source of information leading to the opening of a marijuana cultivation file (see Table 4.7). The most common source of information (57%) comes from Crimestoppers or anonymous informants. While most of the sources of information have remained stable over from 1997-2003, reports coming from neighbours have increased to 10% in

[10] In 2002, the Kelowna detachment was amalgamated to include Lake Country.
[11] In 2002, the Chilliwack detachment was amalgamated to include Aggasiz, Hope and Boston Bar.
[12] Includes the municipalities of Maple Ridge and Pitt Meadows.

2003, from 3% in 1997. Something important for policy makers is that despite bylaws in many municipalities concerning landlord liability in rental growing operations, information received from landlords has not increased over the past seven years. There has been an increase in the number of calls from neighbours as a source. This suggests that public awareness campaigns on how to "spot a grow operation" are successful.

Table 4.7: Source of the Information Leading to Opening of Marijuana Cultivation File/Percentage* From Each Source by Year 1997-2003

*Source***	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Overall*
Crimestoppers or anonymous informants	55 %	57 %	55 %	59 %	57 %	58 %	51 %	57 %
While responding to other crime	12 %	11 %	12 %	10 %	8 %	7 %	7 %	9 %
Landlord	7 %	7 %	8 %	8 %	7 %	7 %	7 %	8 %
Neighbour	3 %	4 %	3 %	6 %	7 %	8 %	10 %	7 %
General investigation	4 %	4 %	6 %	5 %	5 %	5 %	7 %	6 %
Routine check (including road stops)	5 %	6 %	6 %	5 %	4 %	4 %	2 %	4 %
While serving a warrant	3 %	3 %	4 %	2 %	2 %	2 %	5 %	3 %
BC Hydro	8 %	4 %	4 %	3 %	1 %	2 %	2 %	3 %
Other (e.g. fire, government officials)	3 %	3 %	3 %	3 %	8 %	8 %	8 %	5 %

* All percentages have been rounded to the nearest whole number.
** Information identifying a type of source was available in 87% of all cases.
Table adapted from: Plecas et. Al. (2005)

4.1.3 Investigations

There are a number of variables that need to be considered by police when deciding whether to take a marijuana cultivation case through to charge. There needs to be a significant amount of evidence to secure a search warrant and this evidence is often not available. The data show that the number of cases where the initial information received by the police did not lead to further action

has increased significantly from 1997-2003 (see table 4.8). Figure 2.5 shows how the percentage of cases in which the information received led to a full investigation (i.e. usually a search of the premises/property) has decreased steadily since 1997. This decrease in full investigations is mirrored by an increase in initial investigation and "no action" cases. Initial investigation would include cases where there was insufficient evidence to obtain a search warrant. The classification :no action" denotes cases for which no police investigation has occurred. The rise in "no action" cases is important to police managers and police policy makers since marijuana cultivation is an economic enterprise and if the costs of this enterprise do not come close to outweighing the benefits then the number of grow operations is unlikely to decrease.

Table 4.8: Action Taken by the Police After Receiving Information on Suspected Marijuana Growing Operations and the Percentage of Cases in Which a Full Investigation was Conducted

YEAR		*Percentage of Cases Where Action was Taken After Information was Received*		
		Full investigation	**Initial investigation only**	**No action taken**
1997	(n = 1489)	91 %	2 %	7 %
1998	(n = 2342)	83 %	2 %	15 %
1999	(n = 3100)	81 %	4 %	15 %
2000	(n = 4802)	71 %	6 %	23 %
2001	(n= 4464)	60 %	25 %	15 %
2002	(n= 4303)	56 %	27 %	17 %
2003	(n= 4514)	52 %	26 %	22 %

N = 25,014

* Table adapted from: Plecas et. Al. (2005)

The average number of days elapsed from opening the marijuana production file to the date of search (if one occurred) increased from 1997-2000, but then decreased from 2000 to 2003 (see Table 4.9). The source of complaint to the police also affects the length of time between the complaint and police attending the scene. In Figure 4.4, Crimestoppers or anonymous informants have the longest length of time between report and attendance, with an average of 41 days across the seven year period. The average time elapsed for a neighbour report is also lengthy at 30 days. Police managers should focus resources on decreasing the response time to informant and neighbour-based tips to increase the perceived cost of operating a grow op and the perceived reward to the individual making the tip.

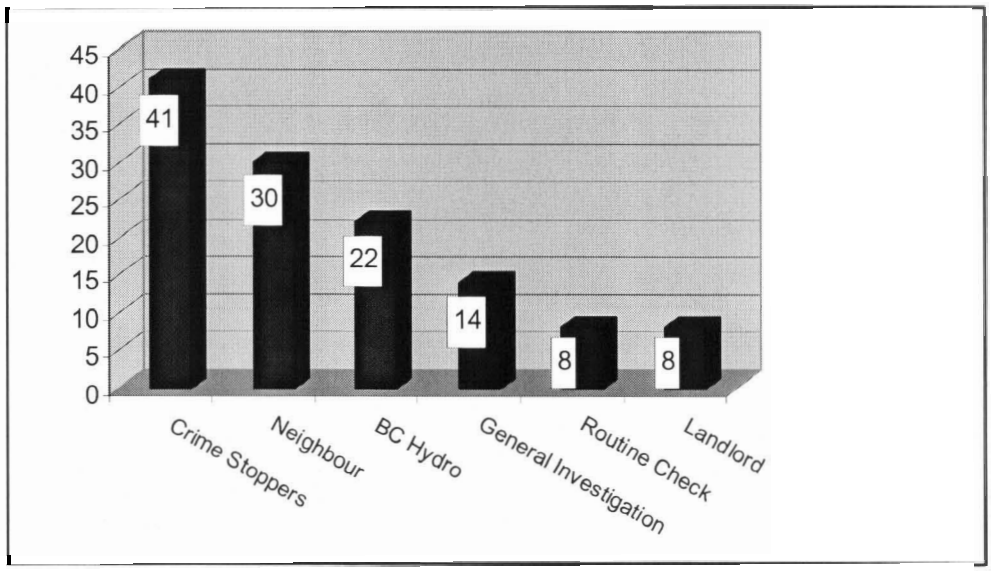
The data show that as the amount of time to investigation increases, the likelihood of the tip being unfounded increases (see Figure 4.5). The fact that the days elapsed in getting to "unfounded cases" is nearly three times as long as the time elapsed for founded cases and more than twice as long as cases "founded but too late" may suggest that a large number of unfounded cases are perhaps not unfounded at all. Rather, many unfounded cases may be nothing more than grow operations that have since moved. This result implies that grow operations and operators are mobile and therefore susceptible to spatial displacement. This issue will be discussed in Chapter 5.

Table 4.9: Average Number of Days Elapsed From Opening Marijuana Cultivation File to Search by Year in BC 1997-2003

Year	***Average Number of Days Elapsed***
1997	**17**
1998	**17**
1999	**24**
2000	**29**
2001	**21**
2002	**21**
2003	**18**

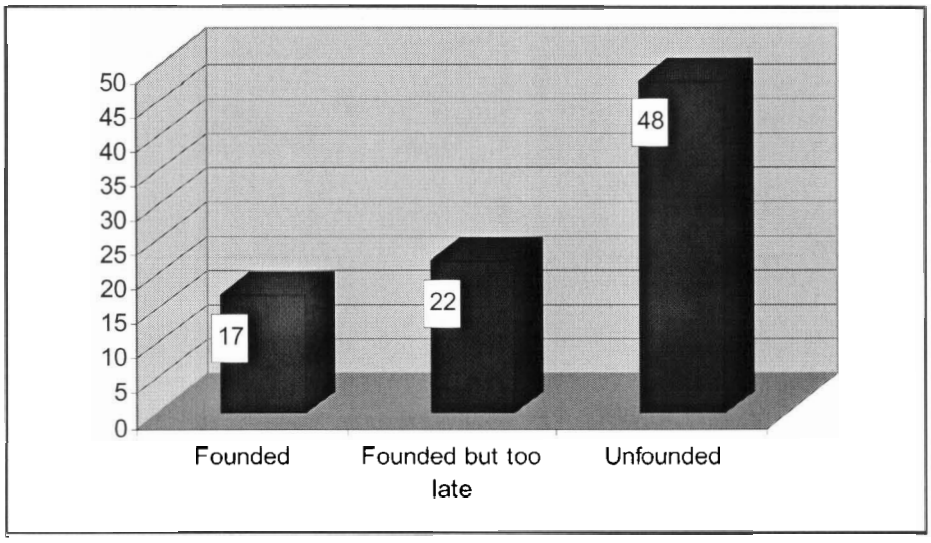
* Table adapted from: Plecas et. Al. (2005)

Figure 4.4: Average Number of Days Elapsed From Opening of a Marijuana Cultivation File to Search (by Source of Complaint) in BC



* Figure adapted from: Plecas et. Al. (2005)

Figure 4.5: Average Number of Days Elapsed From Opening of a Marijuana Cultivation File to Search (by Status of Case) in British Columbia



* All figures rounded.
Figure adapted from: Plecas et. Al. (2005)

4.2 Founded Cases

In the study period, the vast majority (87%) of the full investigation cases were founded grow ops. Another 6% of the cases where a full investigation was conducted evidence existed suggesting that a marijuana cultivation operation had taken place, but the search occurred too late to produce formal evidence. During the year 2003, 45% of all the cases that came to the attention of the police and 86% of the cases where a full investigation was conducted, proved to be founded. Table 4.10 and 4.11 show that the percentage of founded cases have been declining from 1997 through 2003.

Table 4.10: Percentage of Founded Marijuana Cultivation Cases That Came to the Attention of the Police (1997-2003)

Year Cases brought to police attention	*Cases founded and marijuana was seized*	*Evidence of cultivation, but a search occurred too late*
1997 *(n =1,489)*	84 %	3 %
1998 *(n = 2,342)*	75 %	3 %
1999 *(n = 3,100)*	71 %	4 %
2000 *(n = 4,802)*	59 %	5 %
2001 *(n = 4,464)*	53 %	3 %
2002 *(n = 4,303)*	49%	4 %
2003 *(n = 4,514)*	45%	4 %

* All percentages rounded.

Table adapted from: Plecas et. Al. (2005)

Table 4.11: Percentage of Full Investigation of Founded Marijuana Cultivation Cases (1997-2003)

Year Number of full investigation	*Case was founded, marijuana was seized*	*Evidence of cultivation, but a search occurred too late*	*Unfounded***
1997 *(n = 1345)*	93 %	3 %	4 %
1998 *(n = 1959)*	90 %	4 %	6 %
1999 *(n = 2509)*	88 %	5 %	7 %
2000 *(n = 3419)*	82 %	6 %	12 %
2001 *(n = 2667)*	88 %	5 %	7 %
2002 *(n = 2416)*	87 %	7 %	6 %
2003 *(n = 2360)*	86 %	7 %	7 %
Overall Average	**87 %**	**6 %**	**8 %**
N = 16,675	14,483	953	1259

* All figures rounded.

** Unfounded cases did not necessarily involve a formal search (i.e. search warrant). Some cases coming to the attention of the police were classified as "unfounded" by officers following, for example, a follow-up meeting with a landlord, or an inspection on crown land.

Table adapted from: Plecas et. Al. (2005)

4.3 Description of Marijuana Growing Operations

In the seven-year study period, police seized over 2.4 million marijuana plants and 19,325 kilograms of harvested marijuana in BC. The operations appear to be increasing in size every year. This is evident in the number of plants and weight of harvested marijuana seized. With the increase in size, one might expect the harms associated with marijuana growing operations to be escalating. This is partially the case. While most hazards have remained relatively stable in number, an increased incidence of fires and children present in grow ops has occurred.

4.3.1 Characteristics of Grow Operations

The majority of grow ops in BC are indoor, hydroponic operations. Figure 4.6 shows that three quarters of founded grow operations are located within a house or apartment, while only 16% are outdoors, located either on Crown (10%) or private (6%) land.

Figure 4.6: Type of Founded Marijuana Growing Operations in BC (1997-2003)

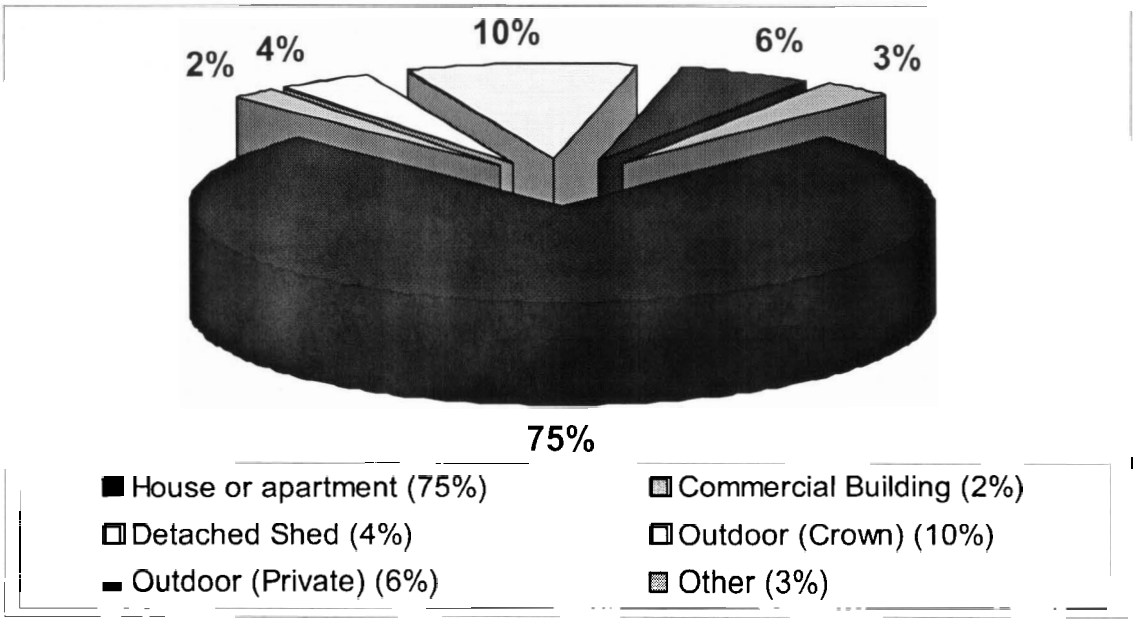


Figure adapted from: Plecas et. Al. (2005)

There are regional differences in the number of outdoor grow ops (see Table 4.12). Outdoor operations are often located through large, coordinated policing initiative called eradication initiatives. The eradications are occasionally proactive, in the sense that many operations are spotted from air or sea without prior knowledge of the location. However, it is more common that the outdoor location comes to the attention of the police from informants, in a similar fashion to indoor growing operations.

Table 4.12: Percentage of Marijuana Cultivation Cases Involving an Outdoor Operation in Each Development Region in BC (1997- 2003)

Development Region	*Percentage of cases involving outdoor cultivation*							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**7 years**
Kootenay	28 %	56 %	36 %	39 %	36 %	32 %	41 %	39 %
Vancouver Island/Coast	25 %	34 %	24 %	24 %	33 %	41 %	45 %	33 %
Thompson/Okanagan	20 %	32 %	26 %	23 %	25 %	21 %	23 %	25 %
North Coast	25 %	17 %	0 %	26 %	14 %	40 %	8 %	20 %
Cariboo	7 %	16 %	7 %	8 %	9 %	4 %	7 %	8 %
Northeast	0 %	17 %	8 %	0 %	1 %	0 %	0 %	5 %
Mainland/Southwest	7 %	7 %	5 %	6 %	4 %	5 %	5 %	5 %
Nechako	0 %	0 %	0 %	11 %	0 %	0 %	0 %	2 %
Province Overall	**15 %**	**22 %**	**15 %**	**13 %**	**15 %**	**16 %**	**19 %**	**16 %**

N = 25,014
*Table adapted from: Plecas et. Al. (2005)

4.3.2 The Size of Operations

Marijuana is seized in two forms: live plant and dried. Table 4.13 shows that the average number of plants seized in marijuana growing operations has increased since 1997. The average number of plants per founded indoor grow operation increased nearly 60% from 1997 through 2003 (see Figure 4.7). Table 4.14 reports the number of kilograms of harvested marijuana seized in each of the seven years.

Table 4.13: Average Number of Plants Involved When Plants Were Seized by Type of Operation in BC (1997-2003)

Type of Operation	*Average Number of Plants Seized in the Province*							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**7 Year Average**
Indoor	149	158	188	192	210	215	236	198
Outdoor	76	103	106	134	118	106	93	106
Other (bunker, trailer, vehicle)	162	118	220	166	78	134	224	128
All types combined	141	140	182	180	194	195	208	180

* All figures rounded.
Table adapted from: Plecas et. Al. (2005)

Figure 4.7: Average Number of Marijuana Plants Seized per Indoor Marijuana Growing Operations in BC (1997-2003)

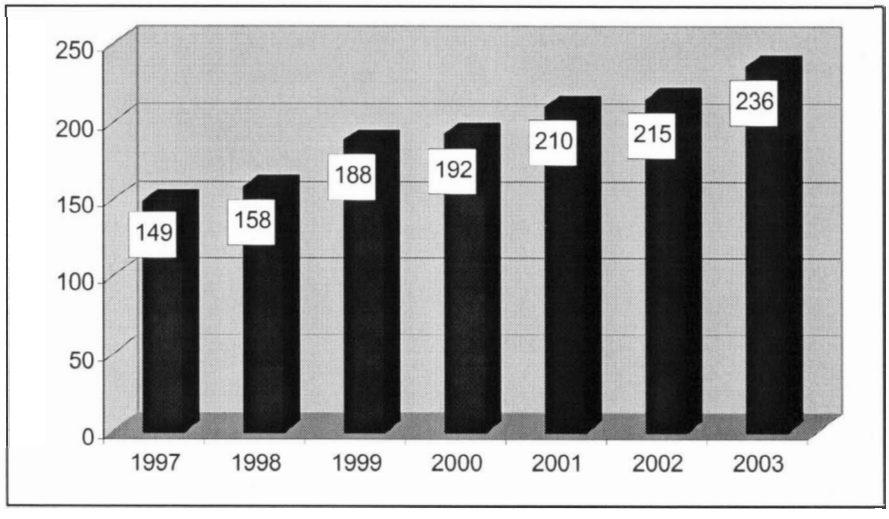


Figure adapted from: Plecas et. Al. (2005)

Table 4.14: Average Number of Kilograms of Harvested Marijuana Seized in British Columbia (1997- 2003)

Type of Operation	*Number of kilograms of harvested marijuana seized*							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total 7 years**
Indoor	2.1	2.7	4.9	4.1	6.5	9.0	6.9	5.2
Outdoor	12.6	5.4	5.2	5.4	10.3	7.0	15.2	8.3
Other (e.g. bunker, trailer, vehicle)	2.1	1.8	3.9	3.3	1.3	3.5	1.7	3.2
All types combined	**2.4**	**2.7**	**4.8**	**4.0**	**6.6**	**8.5**	**7.2**	**5.1**

Table adapted from: Plecas et. Al. (2005)

Table 4.15 shows the combined total of marijuana in plant form and bulk form seized in seven years. The amount of harvestable marijuana per plant is conservatively estimated at 100 grams (or approximately 3.5 ounces) per plant.

Table 4.15: Total Quantity of Marijuana Seized in British Columbia (1997-2003)

Form in which marijuana seized	*Estimated number of marketable kilograms of marijuana seized each year*							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**
In plant form (100 gm / plant)	16,847	22,978	37,565	45,988	41,524	37,240	38,763	240,905
In bulk form aharvested	973	1,368	3,289	3,066	3540	4086	3002	19,325
Total Kilograms	**17,820**	**24,346**	**40,854**	**49,054**	**45,069**	**41,326**	**41,765**	**260,229**

Table adapted from: Plecas et. Al. (2005)

To compare the amount of marijuana produced per grow operation in British Columbia over the 1997 to 2003 period, the following equation is used: (% founded cases in each year where full investigation occurred X total marijuana grow operations calls coming to the attention of police per year) X average

quantity of marijuana seized in founded grow operations per year. It is necessary to use such an estimate because the figures of marijuana actually seized are skewed downward by the fact that over the research period, the percentage of calls for service which led to a full investigation by police has steadily declined (see Table 4.8). Figure 4.8 illustrates that the estimated amount of marijuana produced each year has consistently increased.

Figure 4.8: Estimated Quantity (in Kilograms) of Marijuana produced from incidents coming to the attention of the police

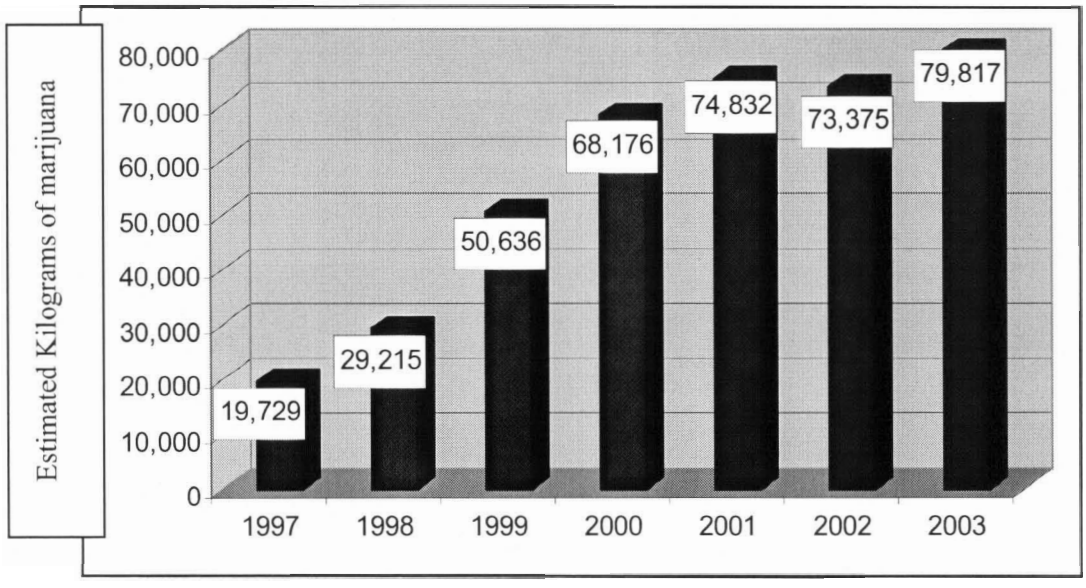
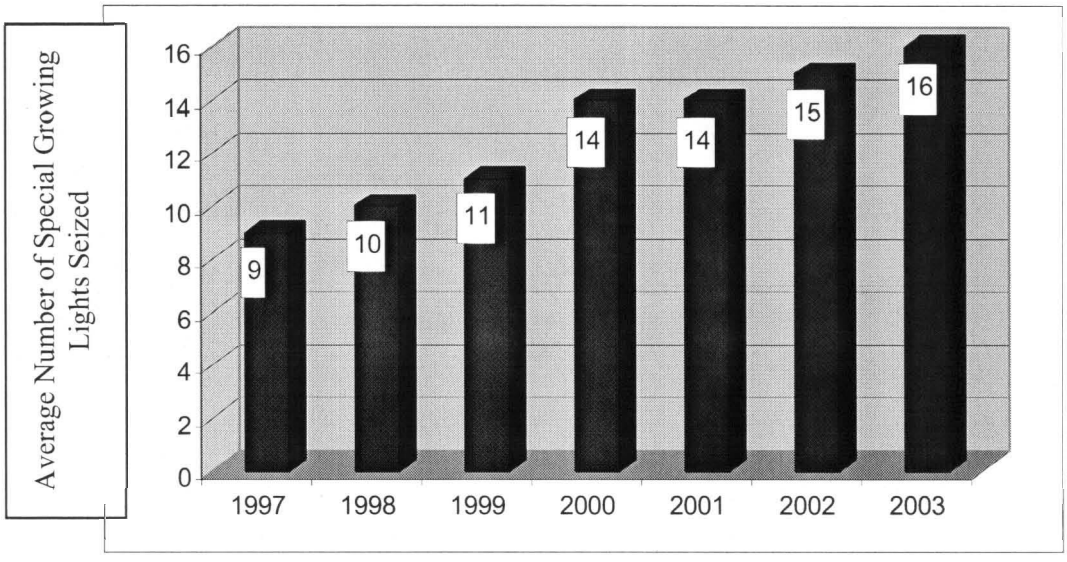


Figure adapted from: Plecas et. Al. (2005)

Another indicator of the increasing size of marijuana growing operations is the number of lights seized. Figure 4.9 shows that the number of lights seized per grow op has been consistently increasing.

Figure 4.9: Average Number of Special Growing Lights Seized From Indoor Marijuana Cultivation Operations in BC (1997-2003)



* Includes some lights seized from trailers, bunkers, or lights boxed in vehicles.
Table adapted from: Plecas et. Al. (2005)

This growth in size of grow operations is reflected in the increasing number of hydroponic stores in BC. From 2000 to 2004, the number of hydroponics stores in British Columbia increased from 101 to 149.[13] [14] The rate of growth in the number of hydroponic stores in British Columbia is six times higher than Washington State and nearly four times greater than Alberta, British Columbia's two closest neighbours (see Figure 4.10).

[13] Kirkpatrick, S., Hansom, D., Plecas, D., and Dandurand, Y., (2002). *Hydroponic Cultivation Equipment Outlets in British Columbia, Alberta and the State of Washington.* Vancouver/Abbotsford: International Centre for Criminal Law Reform and Criminal Justice Policy and the Department of Criminology and Criminal Justice, University College of the Fraser Valley, January 2002.
[14] Determined through systematic online review of 2004 telephone advertisements in British Columbia, Alberta, and Washington State.

Figure 4.10: Rate of Hydroponic Outlets per 100,000 Population in BC, Alberta and Washington State 2004

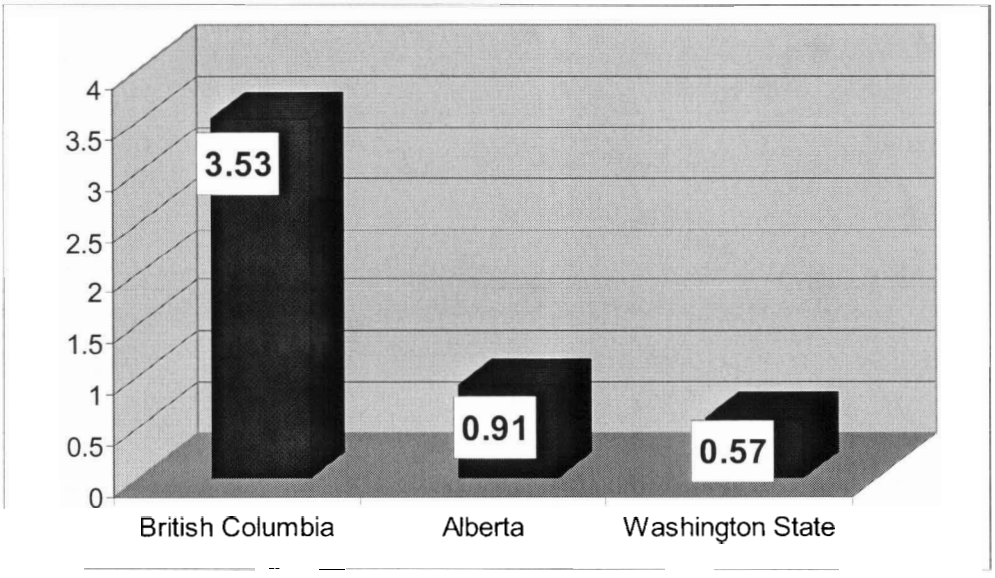


Figure adapted from: Plecas et. Al. (2005)

Indoor marijuana growing operations require large amounts of electricity to power hydroponic lights which accelerate plant growth. This electricity is supplied using a few different techniques: 1) electricity is consumed and paid for 2) electric generators are used, and 3) electricity bypasses are used to steal electricity. According to the police files, the percentage of indoor marijuana growing operations involving the theft of electricity remained relatively stable over the seven years, with an average of 20% of founded cases involving theft of electricity. Unfortunately, the police files only contained limited data on the incidence and value of electricity theft. Table 4.16 summarizes the incidence and amount of electricity theft during the period reviewed.

Table 4.16: Theft of Electricity Involved in Cases of Indoor Marijuana Growing Operations in BC (1997-2003)

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*
Percentage of indoor cultivation cases involving theft of electricity	21 %	14 %	20 %	26 %	16 %	21 %	21 %
Average value of hydro theft per operation *	$ 2,880	$ 3,145	$ 2,563	$ 2,784	$3,152	$ 3,699	$ 3,740
Total $ reported sum of hydro theft*	250,596	207,544	392,166	711,154	438,083	447,628	489,909

* An assessment of the amount of electricity stolen was made in only 47% of the cases. The authors, extrapolating from what the data shows on founded cases and "no action" cases, estimate that the actual amount of hydro theft would have exceeded $3.2 million in 2003 alone.
Table adapted from: Plecas et. Al. (2005)

4.3.3 Potential Harms of Grow Operations

Police managers consider the hazards associated with grow operations to threaten the safety of the community. Table 4.17 summarizes the nature and incidence of founded marijuana grow operation hazards. Hazards were present in only 2.1% of founded cases, and their prevalence remained stable over the seven-year study time frame. The most common associated harm was the presence of a firearm (6.0%) which has increased since 2000. Overall, 15% of indoor grow operations had at least one hazard present (i.e. weapons, fire, other drugs) and that figure overlooks electricity by-passes (i.e. 20% of cases), the presence of mold, and the chance of home invasions, which are not captured in police files. One particularly surprising finding is that children were recorded as being present in 21% of grow operations in the city of Vancouver in 2003. Due to

the lack of consistent record keeping on children present in most other jurisdictions, only 2003 data from Vancouver was used.

Table 4.17: Other Characteristics of Marijuana Growing Operations in BC (1997-2003)

Circumstance	*Percentage of founded cases*
Hazards present (e.g., booby trap, explosives, dangerous chemical product)	2.1 %
Fire involved in indoor grows	3.7 %
Firearms seized	6.0 %
Other drugs seized (e.g. cocaine, heroin)	3.6 %
Other weapons seized (e.g., knives)	2.9 %
Children present (Vancouver 2003)	21 %*

Table adapted from: Plecas et. Al. (2005)

Fire is another significant hazard associated with grow ops. The chance of an indoor grow operation catching fire is significantly higher than other residences. There were 419 fires related to indoor grow operations in British Columbia between 1997 and 2003 (see Table 4.18). Notably, the percentage of indoor grow operations associated to a fire has slightly increased year after year since 1999. In 2003, that percentage reached a seven-year high of 4.7%.

Table 4.18: Number and Percent of Fires Occurring in Founded Indoor Marijuana Growing Operations in BC (1997-2003)

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Overall*
Number of Fires	32	48	51	69	72	67	80	419
Percent of Indoor Grow Operations Resulting in a Fire	3.5 %	4.1 %	3.1 %	3.4 %	3.5 %	3.7 %	4.7 %	3.7 %

Table adapted from: Plecas et. Al. (2005)

Data on all fires occurring in one British Columbia jurisdiction, the City of Surrey, were collected to determine the incidence of fires at grow operations relative to the incidence of fires in general. The official fire data from the Surrey Fire Service were cross-referencing with the grow operation fires in the police records to confirm that the analysis only included those cases that made explicit reference to fires originating from an electrical problem associated to the presence of a grow operation within a single-family dwelling. All reports of grow operation fires occurring in anything other than a single-family dwelling were excluded. The analysis also excluded any incident reports of grow operation fires if the suspected cause of the fire was not clearly and specifically tied to an electrical issue.

Surrey averaged 133 single-family house fires per year from 1997-2003. Given the number of single-family homes in Surrey, this averages to one fire per year per 525 homes (see Table 4.19). The probability of a fire in a home with a grow operation is 24 times greater than for a general single-family dwelling.

Table 4.19: Incidence of Fire at Single Family Residences (SFR) in Surrey for the Period (1997-2003)

Year	*Population of SFRs*	*# of SFRs catching fire*	*Incident Ratio*
1997	**66,637**	**107**	**1 in 623**
1998	**68,152**	**128**	**1 in 532**
1999	**68,703**	**112**	**1 in 613**
2000	**69,703**	**135**	**1 in 514**
2001	**70,599**	**135**	**1 in 523**
2002	**71,777**	**142**	**1 in 505**
2003	**73,118**	**173**	**1 in 423**
Average	69,766	133	1 in 525*

*Includes fires involving grow operations. The incident ratio for fires among the population of grow operations at single family residences for data available for the 1997-2003 period is one in 22 (i.e. based on 23 fires within a population of 513 grow operations).

Table adapted from: Plecas et. Al. (2005)

Table 4.20 shows that out of a total of 173 fires in single family residences in Surrey in 2003, 8.7% involved electrical issues connected to marijuana grow operations.

Table 4.20: Total Number of Fires and Percent of Fires Associated to Electrical Issues Involving Grow Operations in Surrey, BC (1997-2003)*

Year	*# of Fires*	*% Involving Grow Operations*
1997	107	.9
1998	128	6.3
1999	112	6.3
2000	135	5.2
2001	135	3.0
2002	142	1.4
2003	173	8.7
Average	**932**	**4.7**

*Figures based on a review of individual Surrey RCMP police files and cross-checked against individual fire incident reports from Surrey Fire Service. Only grow operations involving single family residences and only those fires confirmed to be associated with electrical issues were considered.
Table adapted from: Plecas et. Al. (2005)

4.4 Suspects

A total of 15,588 suspects were identified out of the 14,483 founded cases of marijuana cultivation in the province during the seven-year study period. Figure 4.11 suggests that the increase in the number of suspects identified each year is a reflection of the concomitant rise in the number of founded cases that proceeded to investigation. The annual number of suspects identified rose sharply between 1997 and 2000 before levelling off from 2001 through 2003.

Figure 4.11: Number of Suspects Identified in Relation to Founded Grow Operations in BC 1997-2003

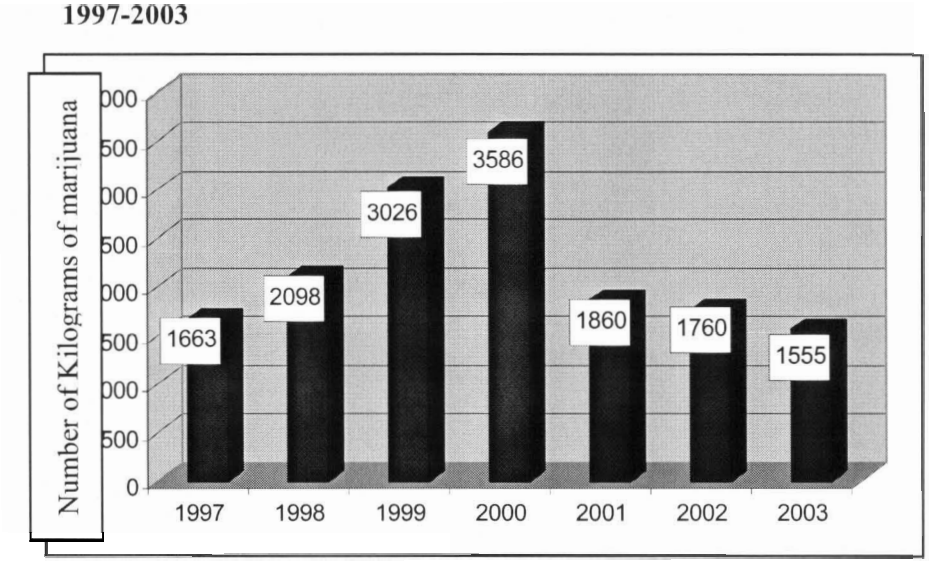


Figure adapted from: Plecas et. Al. (2005)

Characteristics of the suspects involved can be seen in Table 4.21. Seventy-seven percent of all suspects were male, 2% of all the suspects identified were under the age of 18, and the average age of suspects was 35 years old.

Table 4.21: Number, Age, and Ethnic Group of Suspects Involved in Founded Marijuana Cultivation Operations with Suspects Present in BC (1997-2003)

Characteristics	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Overall*
Average number of suspects per case	2.1	2.1	2.3	2.3	1.9	2.0	2.1	2.1
Percentage of suspects who were male	79 %	80 %	78 %	75 %	77 %	74 %	77 %	77 %
Percentage of suspects who were female	21 %	20 %	22 %	25 %	23 %	26 %	23 %	23 %
Average age of suspects	34	34	34	35	35	36	36	35
Percentage of suspects under the age of 18	1 %	2 %	2 %	2 %	2 %	1 %	1 %	2 %
Percentage of suspects from any minority ethnic groups	6 %	9 %	25 %	43 %	41 %	48 %	46 %	31 %
Percentage of suspects of Vietnamese origin	2 %	5 %	21 %	39 %	32 %	39 %	36 %	26 %

N = 15,588
Table adapted from: Plecas et. Al. (2005)

Figure 4.12, below, shows a dramatic shift in the proportion of ethnicities (as measured by place of birth). For 1997 and 1998, and to large degree, 1999, the most frequently occurring ethnicity reported in the suspect data is Caucasian. However, for the year 2000, a dramatic increase in the number of Vietnamese suspects is found. 2000 shows a peak for the proportion of Vietnamese suspect involvement at 39%, a rate that far outpaces the proportion of Vietnamese in the general population. This proportion has remained relatively stable for 2001 through 2003. Other minority groups have increased from 4% in 1997 to 10% for 2003, while Caucasians still are the most common ethnicity, averaging 56% for 1999-2003.

Figure 4.12: Annual Percentages of Suspects Involved in Marijuana Cultivation Operations by Ethnic Group in BC (1997-2003)

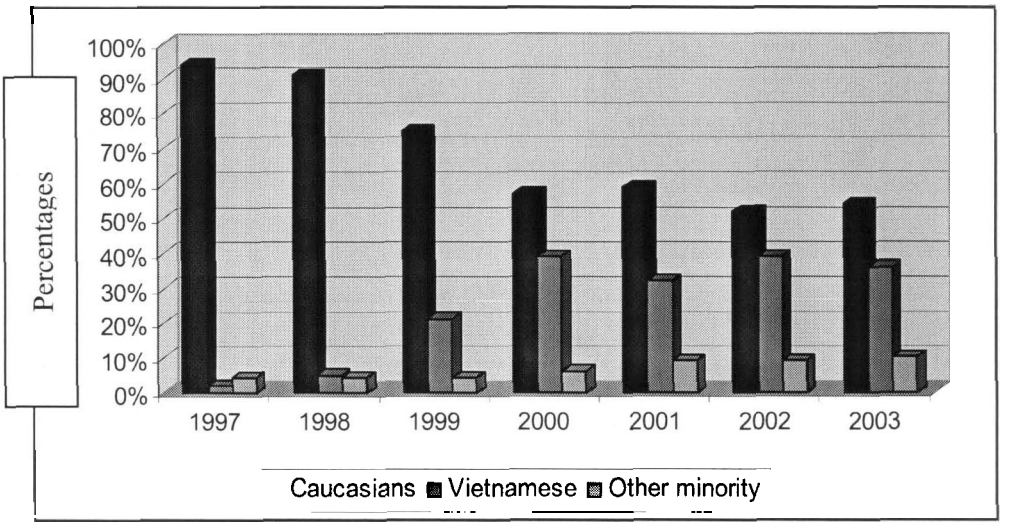
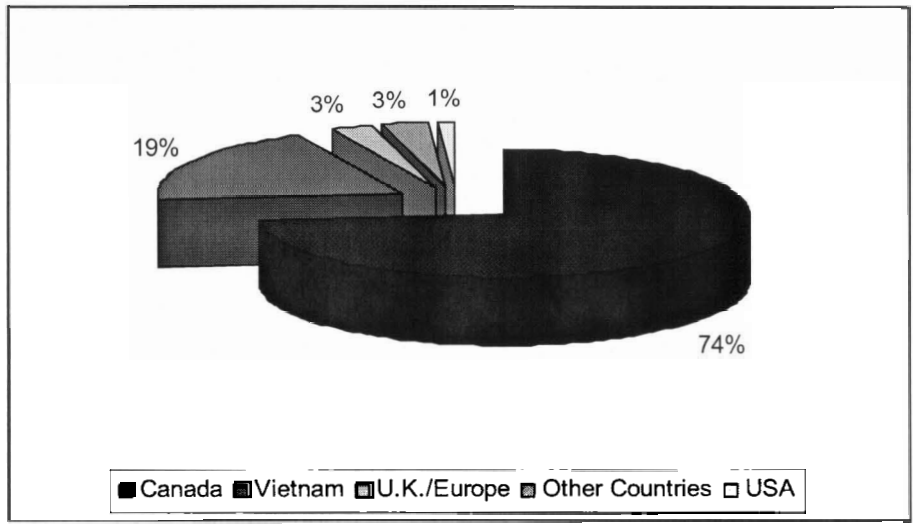


Figure adapted from: Plecas et. Al. (2005)

Figure 4.13 presents the distribution of suspects by place of birth. Seventy-four percent of all known suspects were born in Canada. As suggested in Figure 4.12, above, Vietnam (19%) is the most common country other than Canada as the recorded place for birth. Very few foreign born suspects were from the United States or Europe.

Figure 4.13: Place of Birth of Suspects Involved in Grow Operations in BC (1997-2003)*



*All percentages rounded to the nearest whole number
Figure adapted from: Plecas et. Al. (2005)

4.4.1 Criminal History of Suspects

Each suspect was checked in the CPIC database to determine if he or she had a record of prior criminal convictions. For 20% of these suspects, it was not possible to determine previous criminal history due to incomplete or unmatchable file information. Most common reasons in this regard stem from the incomplete, missing or erroneous recording of: the name, date of birth, fingerprint identifier number—or, rarely—because there was more than one offender with identical details on file. In order to avoid double counting of suspects, imperfectly populated suspect forms were dropped for the criminal history analysis.

Marijuana cultivation suspects typically had a substantial criminal history. Excluding missing cases, 47% of all suspects had prior criminal convictions at the time of investigation. In total, 57% of all suspects had at least one prior

conviction for a drug offence and 41% had a prior conviction involving some form of violence.

The percentage of suspects with a criminal record was lower for suspects of Vietnamese origin (28%), as compared to all other suspects (53%). Table 4.22, however, suggests that, as more suspects of Vietnamese origin were participating in marijuana cultivation operations, proportionately fewer of them had a criminal record. The reason for this is not entirely clear, although it is likely that the data on the criminal history of suspects of Vietnamese origin, mostly first-generation immigrants, did not (and could not) include any information on their prior criminal history while in Vietnam or another country prior to their arrival in Canada.

Table 4.22: Percentage of Suspects with a Confirmed Prior Criminal Conviction Marijuana Cultivation Cases in BC (1997-2003)

Category of suspects	*Percentage of suspects with at least one prior criminal conviction*
All suspects	47 %
All suspects excluding those of Vietnamese origin	53 %
Suspects of Vietnamese origin	28 %

N = 15,588
Table adapted from: Plecas et. Al. (2005)

A more detailed comparison of the criminal histories of suspects of Vietnamese origin with that of other suspects reveals a number of significant differences between the two groups (see Table 4.23). The average length of the

criminal history of the former is a little less than one-half the average length of the criminal history of other offenders and involves, on average, approximately half as many offences. This trend suggests that suspects of Vietnamese origin were recruited later into a life of crime, or their criminal history involved crimes committed in Vietnam or another country and therefore not recorded in the Canadian information system. The criminal records of suspects of Vietnamese origin have almost one-half the percentage of prior violent offences, and are convicted in relatively fewer jurisdictions than for non-Vietnamese suspects. The average period of time between each conviction, however, is shorter in the case of suspects of Vietnamese origin than in the case of other suspects. One in four of the Vietnamese suspects had a prior conviction in the province of Ontario. Over one-half of all suspects, regardless of country of birth, were guilty of at least one controlled drugs and substances offences prior to their suspected involvement with a marijuana production facility.

Table 4.23: Comparison By Ethnic Affiliation of the Criminal Histories of Suspects Involved in Marijuana Cultivation Offences in BC (1997-2003)

Characteristic of suspects criminal record considered	*Suspects of Marijuana Cultivation*		
	All suspects	**Non-Vietnamese**	**Vietnamese origin**
Average length of criminal history	13 yrs	14 yrs	6 yrs
Average number of prior convictions	7	7	3
Percentage with prior drug convictions	57 %	59 %	54 %
Percentage with prior conviction for possession for the purpose of trafficking	27 %	27 %	33 %
Percentage with a prior marijuana cultivation conviction	22 %	22 %	27 %
Percentage with conviction for violent offence	41 %	43 %	23 %
Percentage with conviction for non-compliance offences*	28 %	30 %	16 %
Average number of jurisdictions in which suspects were convicted	2.3	2.5	1.5
Percentage of suspects convicted in Ontario, the most frequent province other than BC where suspects were previously convicted	11 %	10 %	20 %

* Non-compliance offences: (e.g., failure to appear, breach of probation, escape, parole violation, etc.).
Table adapted from: Plecas et. Al. (2005)

4.5 Police Action

One goal of this research is to determine the range of measures taken by the law enforcement and criminal justice system once a marijuana growing operation is uncovered. This section presents the data collected on the charges that were laid and the convictions obtained in cases in which charges were laid by the Crown.

4.5.1 Search and Seizures

The results of the searches and seizures of marijuana growing operations were described earlier in this chapter. In some situations, police officers simply

seized and destroyed the marijuana they found without any further procedure. They usually also seized, deactivated, or otherwise disposed of the equipment involved. These situations are known as "no case" seizures. Law enforcement officers base this type of limited response on the exercise of discretion. It is used in a number of situations, such as when a suspect has not been and is not likely to be identified, the amount of marijuana seized is very small, the case involves a consent search, the investigating officers believe that there may be insufficient grounds for a prosecution, or the search is conducted in such a way or under circumstances such that it would likely render available evidence inadmissible in court.[9]

As seen in Table 4.24, during the seven years period, 54% of all cases involving a search and in which marijuana was seized were dealt with as "no case" seizures. As Table 4.24 also shows, the proportion of "no case" seizures was considerably lower in cases where one or more suspects had been identified (35%). Table 4.25 makes it clear that one of the determining factors of whether or not a "no case" seizure approach was used involved the size of the marijuana cultivation operation. 64% cases with less than 10 plants resulted in a "no case" seizure. This percentage drops consistently as you increase the size of the growing operation. The relative frequency of "no case" seizures varied

[9] The subject of "no case" seizures became somewhat controversial in British Columbia during the period under review, particularly in relation to the activities on the "Growbusters Initiative" in Vancouver. The issue has received a fair amount of media attention and has been the object of a review by the Office of Police Complaint Commissioner. As a result, law enforcement practices in that regard have apparently evolved during the period under review. [See: Campbell, Larry (2001). *The Growbusters Initiative – A Review of Police Conduct, Policy and Procedures*, Prepared for the Police Complaint Commissioner of British Columbia, July 2001].

considerably from one police jurisdiction to another and sometimes also within the one jurisdiction over the seven-year period.

Table 4.24: Percentage of Founded Marijuana Cultivation Cases Classified as 'No Case' Seizures in BC (1997-2003)

Year	*Percentage Which Were "No Case" Seizures**	
	All founded cases	**Founded cases where a suspect was identified**
1997	35 %	23 %
1998	50 %	36 %
1999	43 %	30 %
2000	48 %	34 %
2001	62 %	38 %
2002	66 %	45 %
2003	64 %	42 %
Overall average	**54 %**	**35 %**

* All percentages have been rounded to the nearest whole number.
Table adapted from: Plecas et. Al. (2005)

Table 4.25: Percentage of Founded Cases that Were Classified as 'No Case' by the Number of Marijuana Plants Seized in BC (1997-2003)

Year	*Percentage* Which Were "No Case" seizures*			
	<10 plants seized	**10–49 plants seized**	**50–99 plants seized**	**100+ plants seized**
1997	48 %	29 %	14 %	11 %
1998	59 %	42 %	29 %	21 %
1999	63 %	39 %	25 %	17 %
2000	70 %	37 %	32 %	23 %
2001	63 %	43 %	43 %	29 %
2002	71 %	54 %	52 %	36 %
2003	82 %	54 %	39 %	32 %
Overall	**64 %**	**41 %**	**33 %**	**25 %**

* All percentages have been rounded to the nearest whole number.
Table adapted from: Plecas et. Al. (2005)

As indicated by Table 4.26, from 1997 through 2003, there is an increasingly lower percentage of cases in which charges were laid. The number of cases where charges were laid dropped to 76% in 2003 from over 90% in 1997 through 2001. Figure 4.14 shows how the actual number of suspects charged has also dropped in 2001 through 2003.

Table 4.26: Percentage* of Founded Cases that were not Classified 'No Case' Where Crown Laid Charges in British Columbia (1997-2003)

Year	*Percentage* of Cases in Which Charges Were Laid*	Actual # of Cases in Which Charges Were Laid
1997	96 %	682
1998	94 %	717
1999	94 %	997
2000	94 %	1153
2001	92 %	824
2002	89 %	633
2003	76 %	553
Overall average	**91 %**	**5559**

* All percentages have been rounded to the nearest whole number.
Table adapted from: Plecas et. Al. (2005)

Figure 4.14: Number of Suspects Charged in British Columbia 1997-2003

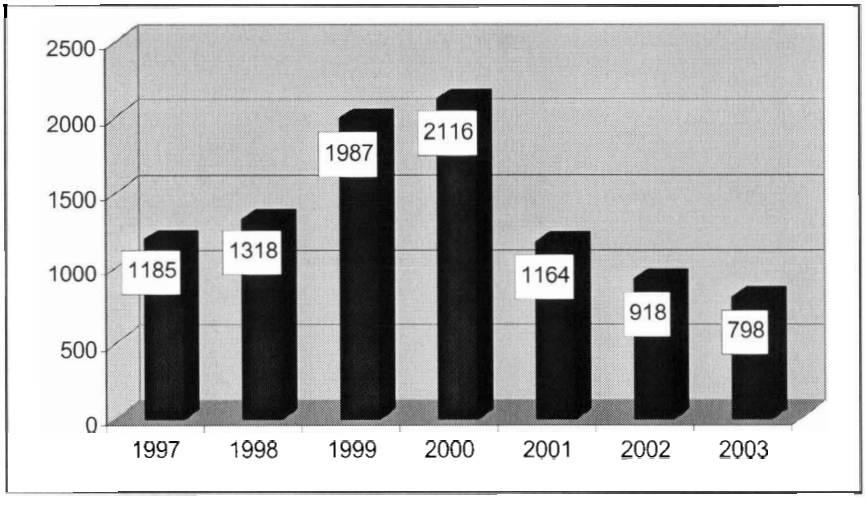


Figure adapted from: Plecas et. Al. (2005)

4.5.2 Charges

A grow operation file is reported to Crown Counsel once charges are laid. If a Crown Counsel report is submitted, the likelihood of formal charges being laid

against one or more of the suspects is very high (91%). The total number of charges relating to marijuana cultivation is presented in Table 4.27. All charges show a substantial decrease since 2001, due in large part to the increasing number of "no case" seizures.

Table 4.27: Total Number of Charges Relating to Marijuana Cultivation Incidents in BC (1997-2003)

Charge	*Charges laid in relation to marijuana cultivation incidents*							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Overall**
Production/cultivation	1113	1241	1900	2028	1063	843	732	8920
P.P.T.*	835	992	1539	1626	819	659	531	7001
Simple possession	240	210	262	235	156	100	85	1288
Theft of electricity	177	137	348	432	182	154	81	1511
Firearms	100	112	107	100	36	34	22	511
Other Criminal Code	102	67	144	90	64	74	53	594
Total	**2567**	**2759**	**4300**	**4511**	**2320**	**1864**	**1504**	**19,825**

* Possession for the purpose of trafficking.
Table adapted from: Plecas et. Al. (2005)

Table 4.28 shows that the majority of the 9,486 suspects charged for marijuana cultivation were given a primary charge of marijuana production (S.7 C.D.S.A). The majority of cases included more than just a production charge, with the most frequent attending charge being for the purpose of trafficking.

Table 4.28: Percentage of Charged Suspects by Type Of Charges: Marijuana Cultivation Operations in BC (1997-2003)

Charge	*Percentage* of offenders charged*		
	By offence	**In addition to a production charge**	**One offence and no other**
Production	94 %	-	16 %
P.P.T.***	74 %	71 %	2 %
Simple possession	14 %	11 %	2 %
Theft of electricity	16 %	16 %	0 %**
Firearms	5 %	5 %	0 %**
Other Criminal Code	6 %	5 %	0 %**

N = 9486

* All percentages have been rounded to the nearest whole number.

** When combining theft, firearms related offences, and other Criminal Code offences, the total number of such of charges is 63, which is less than 1% of the total.

*** Possession for the purpose of trafficking

Table adapted from: Plecas et. Al. (2005)

33% of the total charges were not yet disposed at the time of data collection. Therefore, the following analysis is based on 13,329 charges laid that had received a disposition. These charges involved 6,487 offenders.

4.5.3 Dispositions

Slightly less than half (44%) of the suspects received a stay of proceedings if a report to Crown Counsel was filed (see Table 4.29). Interestingly, there is no substantial difference in the likelihood of having all charges stayed based upon the number of charges laid. However, gender does seem to have an effect. In cases where a female was the only suspect, the proceedings were stayed in 33% of the cases, whereas only 22% of the cases were stayed for male suspects.

Table 4.29: Percentage of Suspects whose Charges Were Stayed: Marijuana Cultivation Cases in BC (1997-2003)

Number of charges faced by suspect	*Percentage* of suspects** and stay of proceedings*		
	All charges stayed	**Only some charges stayed**	**None of the charges stayed**
One charge	42 %	--	58 %
Two charges	46 %	42 %	12 %
Three charges	43 %	48 %	9 %
Four charges	48 %	46 %	6 %
Five charges	35 %	59 %	6 %
Six charges	0 %	0 %	100 %
Total suspects	**44 %**	**36 %**	**20 %**

* All percentages have been rounded to the nearest whole number.
** Includes only suspects in cases where charges had been disposed of at the time of data collection.
Table adapted from: Plecas et. Al. (2005)

Table 4.30: Gender of Suspects in Whose Case Proceedings Have Been Stayed With Respect to All Charges in Marijuana Cultivation Cases in BC (1997-2003)

Number of charges faced by suspects	*Percentage* of suspects** for whom all charges were stayed*		
	Males	**Females**	**Overall**
One charge	34 %	66 %	42 %
Two charges	37 %	74 %	46 %
Three charges	35 %	70 %	43 %
Four charges	39 %	83 %	48 %
Five charges	17 %	80 %	35 %
Six charges	0 %	0 %	0 %
Overall	**36 %**	**72 %**	**44 %**

* All percentages have been rounded to the nearest whole number.
** Includes only suspects in cases where charges had been disposed of at the time of data collection.
Table adapted from: Plecas et. Al. (2005)

Table 4.31 shows that a very low percentage (4%) of charges, accused, and files results in not guilty verdicts and only 30% of approved charges resulted in convictions. However, 73% of the cases associated with those approved charges resulted in at least one accused being found guilty. It would appear that Crown Counsel is trading off charges and the involvement of multiple accused to increase the likelihood of securing a conviction in individual cases.

Table 4.31: Summary Comparison of Action Taken on the Charges, Accused, and Files Associated with Cases Approved by Crown Counsel in Marijuana Cultivation Cases in BC (1997-2003)

Status	*Charges Involved*	*Accused Involved*	*Files Involved*
Number approved	13,329	6487	4136
Number stayed	8748	2863	932
	(66%)	*(43%)*	*(23%)*
Number referred to court	4581	3624	3204
	(34%)	*(56%)*	*(77%)*
Number found not guilty	517	230	173
	(4%)	*(4%)*	*(4%)*
Number resulting in conviction	4064	3364	3008
	(30%)	*(52%)*	*(73%)*

*Percentage in brackets represents percentage of number approved.
Table adapted from: Plecas et. Al. (2005)

4.6 Conclusion

This chapter demonstrates that British Columbia's marijuana cultivation industry increased dramatically from 1997 through 2000 and then appeared to level off from 2000 through 2003. There are a number of possible reasons for this plateau. First, perhaps marijuana grow operations are becoming more sophisticated and more difficult to detect. Second, the impact of international

security initiatives as a result of the terrorist attacks on September 11th, 2001 may have made it more difficult to export marijuana across the Canada – United States border. This increased difficulty might have restricted the growth of the export market from 2001 through 2003 and led to local market saturation. Third, it is possible that individuals are not reporting suspected marijuana grow operations as often as they were in 2000. However, the data presented in this chapter on source of complaint do not support this hypothesis. Another possible explanation is that current police initiatives (i.e. green teams) have increased the costs of marijuana production in BC. This explanation will be tested in the next chapter.

Another interesting finding concerns the significant increase in the number of suspects of Vietnamese origin; particularly in areas with a large increase in the number of grow operations. The police hypothesize that Vietnamese organized crime has effectively taken over the production of marijuana in certain jurisdictions and that they work with other criminal organizations (i.e. Hells Angels and Southeast Asian Groups) to distribute the drugs. Chapter Six explores the dynamics of organized crime involvement within the marijuana cultivation industry in BC.

5 A SPATIAL ANALYSIS OF GREEN TEAMS: A TACTICAL RESPONSE TO MARIJUANA PRODUCTION

5.1 Introduction

In evaluating policies that target behaviors of particular groups (e.g., local welfare policy) or within specific geographic areas (e.g., economic development or tax policies), it is not enough to focus on the impacts solely within the targeted population/area. Instead, one must be cognizant of behavioral changes occurring on the periphery of the targeted group/area. That is, targeted policies may yield unexpected externalities (either positive or negative) that impact the behavior of non-targeted groups or in non-targeted areas. That is why it is essential to consider issues of "displacement" when weighing the full costs and benefits of a targeted policy. When local jurisdictions are free to exercise discretion in choosing particular policy interventions, the success or failure of the policy is likely to be dependent upon the choices made in neighboring areas.

There are many different types of policies where displacement effects are central. For instance, local efforts to legalize gambling or build professional sporting arenas often rest upon the promise of generating increased consumer spending and tax revenue within the targeted development areas. However, researchers have demonstrated that even when casinos and stadiums do increase consumer spending locally, these monies are being diverted from entertainment alternatives in surrounding areas (Coates & Humphries, 1999;

Eadington, 1995; Siegel & Anders, 1999). The evaluation literature on local excise taxes levied on such goods as gasoline, cigarettes, and liquor demonstrates that another type of displacement effects occurs when differentials in tax levels induce "boundary crossing" behaviors on the part of consumers seeking cheaper goods (Beard, Grant, & Saba, 1995; Coats, 1997; Saba, Beard, Ekelund Jr., & Ressler, 1995). The decision to adopt an increase in local excise taxes is often jointly considered along with tax policy in geographically proximate areas (Nelson, 2002).

Geographically targeted criminal justice policies represent another context where displacement effects need to be considered. At a broad level, rational choice theorists believe that increasing severity of punishment in one jurisdiction will lead offenders to commit crimes in areas with more lenient sentencing (see Bailey and Peterson, 1999). At a more local level, local governments rarely have the resources needed to combat major problems (drugs, gangs, prostitution) across all locations simultaneously. Driven by political pressures, community demands, and economic constraints, it is often necessary to geographically target interventions within specific neighborhoods or communities. This is especially true when the intervention takes the form of a "crackdown" against a particular behavior.

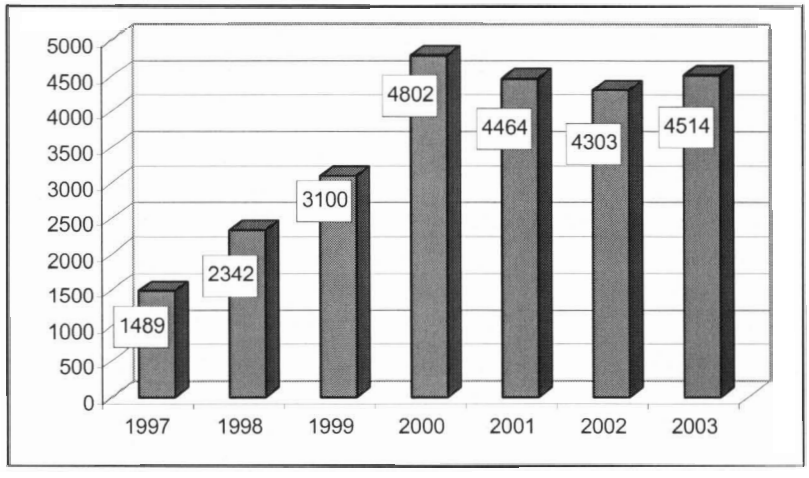
Police crackdowns are defined as "sudden and dramatic increases in police officer presence, sanctions, and threats of apprehension either for specific offenses or for all offenses in specific places" (M. S. Scott, 2003). Crackdown efforts are appealing to the public, policy makers and the police because they

offer quick, immediate action in response to crimes that seem to be rapidly increasing and threatening public order and safety (M. S. Scott, 2003). Many such efforts have been shown to be effective in reducing specific crimes in specific locations (A. Braga, 2001; McGarrell, Chermak, Weiss, & Wilson, 2001; Weisburd & Green, 1995). There is also evidence that geographically targeted crackdowns have led to instances of positive externalities or a "diffusion of benefits" where the positive treatment effects are seen outside of the target area (A. Braga, 2001; Grogger, 2002). However, targeted crackdowns can also have negative consequences. First off, the effects of crackdowns appear to be short-lived. Once the resources are removed or the operation ends, there often is little or no lasting deterrent effect (J. Cohen & Ludwig, 2002; Sherman & Rogan, 1995; Tita et al., 2003b). Crackdowns also have been shown to have a negative impact on police-community relations (Maher & Dixon, 2001; Sherman, 1997), increase the potential for abuse by police (Davis & Lurigio, 1996), and divert funds from other areas of policing (Davis & Lurigio, 1996; Green, 1996). The most common criticism of geographically targeted crackdowns, however, centers on the issue of displacement (Davis & Lurigio, 1996; Kennedy, 1993; Wood et al., 2004). That is, opponents of these efforts argue that they do little to reduce overall levels of crime. Instead, they contend that crime is simply pushed out into the areas surrounding the targeted area. I address the displacement criticism by examining the adoption of drug enforcement policies aimed at curbing marijuana production in BC and explore whether crackdowns were successful in reducing

production, or whether the interventions simply displaced the production to neighboring areas.

As mentioned in the previous chapter, from 1997 – 2000 BC experienced tremendous growth (over 300%) in the reporting of illicit production facilities. Following 2000, there has been a basic leveling off of the problem (see Figure 5.1).

Figure 5.1: Grow Operations 1997-2003



While the increase began in the heavily-populated regions close to the United States border, similar increases were observed in virtually every police jurisdiction in the province. Police managers and local politicians were eager to react to the increase in grow operations due to the perceived involvement of organized crime and the hazards[15] associated with this form of illicit drug production. Around the end of 2000, most policing jurisdictions had adopted a particular policy in response to the proliferation of grow operations.

[15] Approximately 30% of indoor grow operations have at least one hazard (i.e. weapons, fire, other drugs, electricity by-passes, presence of mold, and home invasion).

Police in jurisdictions chose one of four options. Only one of these options was a targeted crime reduction effort specifically aimed at reducing marijuana grow operations. The majority chose to simply maintain the status quo wherein enforcement of police initiated investigations and citizens' tips continued in the same manner before, and during, the increase in grow operations. Others became disenchanted with the cost-benefit of investigating and prosecuting operations and actually suspended the majority of investigation and enforcement activities concerning grow operations. The remaining jurisdictions took a more aggressive stance toward marijuana production. Some agencies implemented or reinforced existing resource intensive drug squads, which focused on all aspects of trafficking, sales and production of all types of drugs. Finally, the remaining jurisdictions formed specialized tactical units that focused solely on the enforcement of marijuana production.

In the next section, some background on the policing jurisdictions that comprise BC and the various policy responses are discussed. The focus is primarily on the adoption of "green teams" and the ways in which one would expect them to be successful in reducing production. Understanding the mechanisms of policy to also provide the context by which one might expect the adoption of such crackdowns to lead to displacement. After discussing the data, the analytical plan is outlined in more detail. A comparison of the results achieved in the reduction of marijuana production by adopters of green teams versus other policy regimes is then conducted. Special attention is paid to how

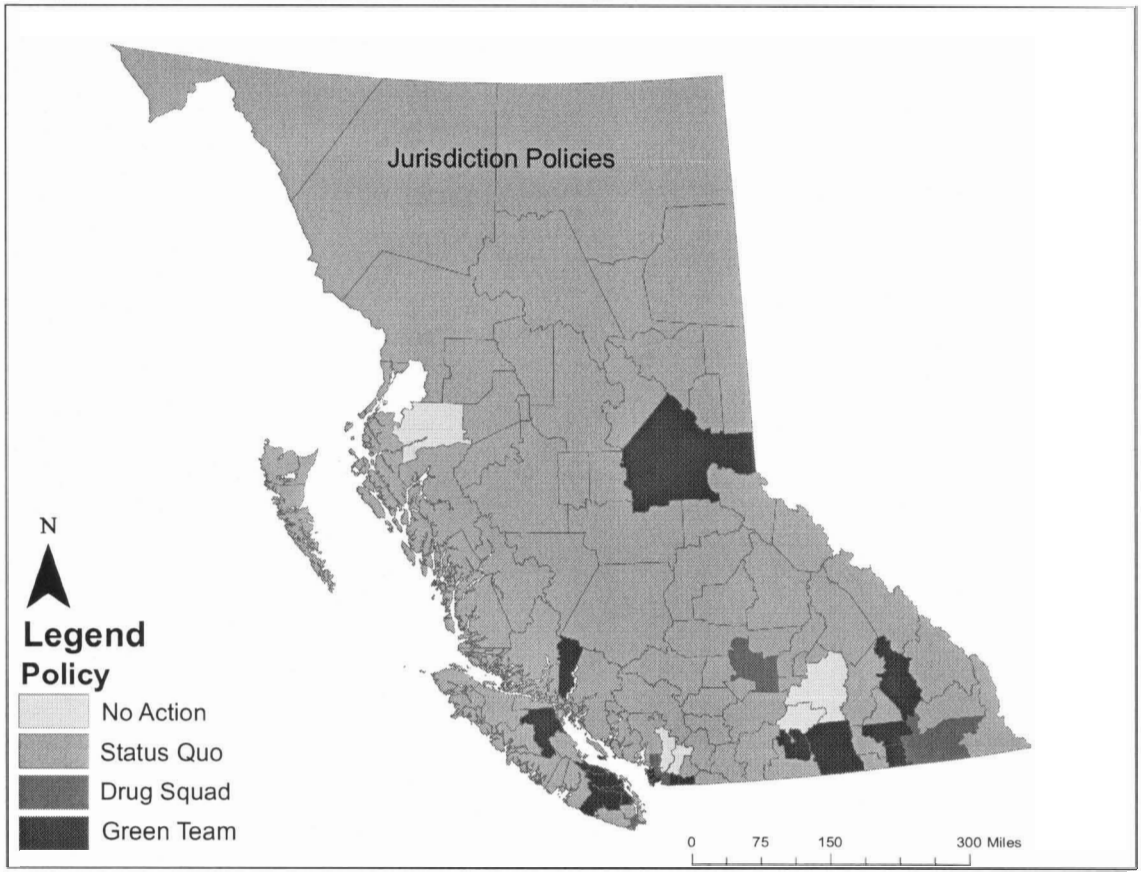
production faired in those jurisdictions neighboring the adopting jurisdictions. The chapter concludes with a discussion of the findings.

5.2 Police Response to Marijuana Grow Operations in BC

The structure of policing in BC consists of autonomous municipal departments and Royal Canadian Mounted Police (RCMP) detachments. Each municipal department or RCMP detachment is essentially independent with limited sharing of information and services across jurisdictions. While the RCMP is a national policing agency, it is often contracted by provincial and/or municipal governments to deliver police services, and as such, individual RCMP detachments and municipal departments are responsible for introducing their own policies in response to issues of crime within their community.

Figure 5.2 illustrates the policing jurisdictions in BC and the policies adopted in response to marijuana grow operations within each area at the end of 2000.

Figure 5.2: Jurisdiction Policies



The majority of jurisdictions (74%) chose to continue investigating tips and enforcing grow operations as they had been over the previous three years. No additional resources were specifically dedicated to counter grow operations and the departments/detachments were able to maintain a relatively constant rate of grow operation investigation. These "status quo" jurisdictions tended to be in smaller, more rural settings or in urban settings with a smaller increase in marijuana cultivation relative to other areas.

A small number of jurisdictions (4%) dramatically reduced the level of investigation and enforcement of grow operations files. The decision to decrease investigations appears to be based on a mixture of fiscal constraints and disillusionment with the lenient treatment of convicted marijuana producers by the Canadian courts. These "no action" jurisdictions were all urban centres that had seen a sharp rise in grow operations from 1997 through 2000.

Some agencies (7%) implemented or reinforced existing drug squads, which focused on all aspects of trafficking, sales and production of all types of drugs. Given the resource-intensive nature of this dedicated "drug squad" policy, it is not surprising that those departments choosing to maintain a drug squad come from either larger, more urban centres, or groups of smaller, more rural departments that combine resources to share costs and services. Finally, some of the jurisdictions (14%) formed specialized tactical units that focused solely on the enforcement of marijuana production.

To understand how these tactical units may reduce grow operations, and potentially lead to displacement, some background on the teams is helpful. Whether known by colourful names such as "green team", "grow busters", "bud busters" or more formally "marijuana enforcement team", these units have the specific purpose of policing marijuana growing operations across their entire police jurisdiction. While increasing police presence and the threat of grow operation detection is part of their mandate, they have no ability to impact the range of typical sentences received for successful convictions. This is partly due to the inability of the criminal justice system to deal with the scope of the

problem, and partly because of the gray area surrounding marijuana policy in Canada[16].

The teams investigate all of the grow operation files for the department. The process begins with public tips pertaining to marijuana production being forwarded to the unit. The unit, made up of staff from police, community services, fire services and electricity providers, then investigates the tip. The teams are built upon the premise that a dedicated, multi-agent team will better facilitate sharing of information and allow for more successful investigations. The teams also run publicity campaigns that educate citizens on the function of the green team, how to "spot a grow operation", and the hazards associated with this form of drug production.

This chapter focuses on evaluating the success of green teams in reducing marijuana production compared to the other three policy options outlined above. By using a Geographic Information System (GIS) to identify where the policy was implemented, issues of effectiveness and displacement are explored. That is, does an effective detachment reduce marijuana production within the jurisdiction, and does it do so at the cost of displacing the problem to nearby areas? Or, as the crime displacement literature often supports, does the

[16] The question of whether marijuana use should be legalized or decriminalized has been argued by policy makers for the past thirty years. While no formal changes in marijuana policy have occurred during this time, the Canadian criminal justice system has changed the way it deals with drug possession, distribution, and production through charging and sentencing practices. These changes reflect the Canadian public's relaxed views on drug use, specifically marijuana. However, while the criminal justice system is dramatically lessening the clearance rate and sentences for marijuana possession, instances of marijuana cultivation and distribution are increasing dramatically.

benefit of having a green team in a neighbouring jurisdictions diffuse into surrounding areas?

The use of GIS in policing and crime reduction has increased dramatically over the past decade. GIS is used to support policing by serving as a tactical tool that aids in the design and implementation of specific policing strategies and investigations. GIS is also used as a strategic instrument that supports the evaluation/assessment of decision-making within the department. More specifically, GIS and crime mapping: maps police activity and crime reduction projects; identifies crime hotspots for targeting, deploying and allocating police services and crime reduction initiatives; allows for visual communication of crime patterns and statistics to the public; and assists in the assessment of crime reduction policy initiatives (Chainey & Ratcliffe, 2005). It is in the latter evaluative capacity that GIS is employed in this research. Before describing the data used in this chapter, the displacement literature, with specific focus on police crackdown efforts, is reviewed.

5.3 Displacement Literature

The issue of displacement is a primary concern to police managers and crime prevention policy planners and practitioners. The question of whether tactical, operational, and/or crime prevention responses actually reduce criminal activity or whether the initiatives simply displace crimes spatially and temporally is vital in policy evaluation. While there is rich literature on displacement theory (Brantingham & Brantingham, 2003; J. Eck, 1993), there has not been extensive

research on the incidence of displacement or on advancing measurement techniques. This aside, the available research indicates that spatial displacement does exist, but it is not serious enough to hinder crime prevention policies (Brantingham & Brantingham, 2003). Studies show that situational crime prevention techniques, which often include tactical and operational interventions, repeatedly result in a reduction of crime in the target area without significant displacement to other areas (A. A. Braga et al., 1999; Brantingham & Brantingham, 2003; Clarke, 1997; J. Eck, 1993; R. Hesseling, 1994; Knutsson, 1998; McGarrell et al., 2001; Novak, Hartman, Holsinger, & Turner, 1995; Smith, 2001). In fact, crime prevention initiatives occasionally result in a diffusion of benefits where crime incidents are reduced in the target area and surrounding areas (Clarke & Weisburd, 1994; Repetto, 1974). However, there are criminal activities, such as open drug markets, where partial displacement is evident (Greene-Mazerolle, Price, & Roehl, 2000; Maher & Dixon, 1999).

While open-air drug markets are clearly a different crime phenomenon than illicit drug production, both are linked by a resilient underground economy; therefore, the research on spatial diffusion in open drug markets is specifically relevant to this study. The research in this area presents mixed results. Weisburd and Green (1995) looked at the effect of police enforcement of drug crimes and license regulation of business owners on drug hotspots in Jersey City, New Jersey. They found strong evidence for reduction of disorder-related calls with no evidence of displacement and some diffusion of benefits. Smith (2001) evaluated a crime control initiative in Richmond, VA, where patrols in the

drug market were supplemented by specialized tactical teams and clean-up and repairs to buildings and landscaping. There was a significant treatment effect with no evidence of spatial displacement of crimes and once again a diffusion of benefits. Some studies on open drug markets have found significant treatment effects with displacement to indoor locations (Kennedy, 1993; Maher & Dixon, 2001). Some research evaluating crime prevention techniques in open drug markets have found evidence of expansion diffusion. Expansion diffusion occurs when there is an increase in crime in areas adjacent to the treatment area while crime levels within the core region remain high. Wood et al. (2004) evaluated a police crackdown in Canada's largest heroin market in Vancouver, BC. The results, primarily on needle disposal data, indicate expansion diffusion, with no significant reduction in drug use in the core area based on needle exchange indicators, but significant displacement of drug use outside of the treatment area. The literature presented above illustrates a partial displacement in open drug markets after policies similar to the green teams under study are implemented. Our question here is, should one expect a similar displacement or diffusion of benefits in drug production sites?

Marijuana production is especially susceptible to spatial displacement due to the suspected involvement of organized crime. By definition, individuals involved in organized criminal networks communicate with one another for purpose of information sharing (Williams, 2001). It follows that people involved in illicit marijuana production would share information about high-risk jurisdictions, where a grow operation would be more likely to be discovered by law

enforcement. Unlike open drug markets, where a significant amount of business is gained by maintaining a stable location, there is little tying grow operations to a particular jurisdiction. One might also expect a diffusion of benefits outside of the police jurisdiction due to a perception that increased police activity mobilizes community action and results in more public tips, resulting in a regional displacement where growers move outside of a region rather than just to a neighboring jurisdiction. While the literature on the policing of marijuana production is not well developed, a study by Potter, Gaines, and Holbrook (1992) evaluating a marijuana eradication effort in Kentucky supports the above statements. The authors found no significant reduction in outdoor marijuana production and an increase in smaller scale production that ultimately dispersed over a larger area following the crackdown. Other negative consequences of the eradication include increased public support for the marijuana industry, an increase in the quality of marijuana, and an increase in the sophistication of the operation.

Another reason to expect displacement involves the purely economic factors that drive any market, including illegal markets. If the police are successful in increasing the costs of crime by increasing the likelihood of apprehension (certainty) or by increasing fines/sentencing for offenders (severity), then we should expect actors in the market to react rationally. That is, operators will shut down their business if the costs of doing business outweigh the benefits. When enough operators in a jurisdiction are arrested or otherwise driven out of the market, supply of marijuana will decrease. So long as demand is

left unchecked, the supply shortage will lead to a noticeable increase in price, especially within the local market. The increase in price will, in turn, entice new entrepreneurs to enter the market in those jurisdictions where local policies have not succeeded in raising the costs of crime. Therefore, even if the operators themselves (organized or individual) are not "displaced" to surrounding jurisdictions, new operators in jurisdictions where the costs of production are not so high will enter the market. Thus, one might expect jurisdictions that border on places where green teams were adopted to experience the greatest increase in growth.

5.4 Data

To determine whether green teams affect reported grow operations, data on marijuana production files from 1997 to 2003 from every law enforcement jurisdiction in BC was assembled. These data were collected as part of a larger study that examined the scope of grow operations and the criminal justice response (Plecas, Malm, & Kinney, 2005). Data pertaining to the type of policy adopted in each jurisdiction, the date of implementation, and for the few cases where the effort was abandoned, the end date were also collected.

Displacement studies of crime within the criminological literature often utilize point pattern analysis of incident data displayed at the individual address level. By observing changes in the spatial pattern of incidents in both the treatment area and neighboring control regions, conclusions are drawn as to whether the intervention results in absolute reductions in crime or simply displaces it. The current research is not amenable to point pattern analysis

because the implementation of the policy occurred throughout the entire policing jurisdiction and not specific neighborhoods. Therefore, by definition, displacement can only occur when grow operations move across jurisdictions. Unlike most interventions that target small sub-city level units that tend to be relatively homogenous such as neighborhoods or parts of a community, policing jurisdictions are large and heterogeneous.

In addition to the intra-jurisdictional heterogeneity, policing areas in BC vary greatly in population and geographic area. To compare events at this level of analysis, it was necessary to aggregate individual events into yearly counts. The implication of using this aggregate level of analysis is that if the policy was enforced differently throughout a jurisdiction, there may be instances of true crime displacement that this research is unable to capture. For instance, if grow operations close to the jurisdiction's borders were enforced less rigorously than operations deeper within the jurisdiction, displacement may occur intra-jurisdictionally rather than inter-jurisdictionally. Under such conditions, even with a demonstrated program effect, there is a bias against finding a displacement effect.

The relatively large unit of analysis and unequal distribution of population present an additional challenge. The original goal was to employ a quasi-experimental design involving propensity score techniques (see Rosenbaum and Rubin, 1983, 1984), to create a control group of observations that closely resemble the jurisdictions that adopted green teams. This technique is becoming increasingly popular in the evaluation of criminal justice/drug policy (McCaffrey,

Ridgeway, and Morral 2004; Ridgeway 2006; Tita et al. 2003) as well as measuring the costs of crime (Greenbaum and Tita 2005). Because the population of BC is so highly skewed, it is not possible to create comparison areas statistically similar to the treatment areas in terms of population size and composition, measures of income, police expenditures, and size of police force[17].

5.5 Analysis

Table 5.1 reports the annual counts of reported grow operations for the years 1997-2003. The first row reports the counts for all adopting jurisdictions while the second and third rows report the numbers for neighboring non-adopting jurisdictions and the total of all jurisdictions respectively. The difference in scale between areas is attributable to the fact that green teams tend to be applied in jurisdictions with the highest annual grow operation counts. Counts are employed because several jurisdictions have very low population, but relatively high numbers of grow operations. Standardizing by population resulted in the creation of several extreme outliers in the overall distribution and thus we settled upon counts. By graphing these numbers (see figure 5.3), it is clear that the slopes between adopters and non-adopting neighbors differ significantly. However, it would be premature to conclude that the effect on grow operations is truly the effect of adopting grow teams. Many other factors could be influencing changes in production that have little to do with the particular policy. For instance, it is plausible that areas that adopted green teams experienced unobservable shifts

[17] Most of the jurisdictions that adopted green teams were in the heavily populated lower mainland region, and most of the jurisdictions in this area adopted.

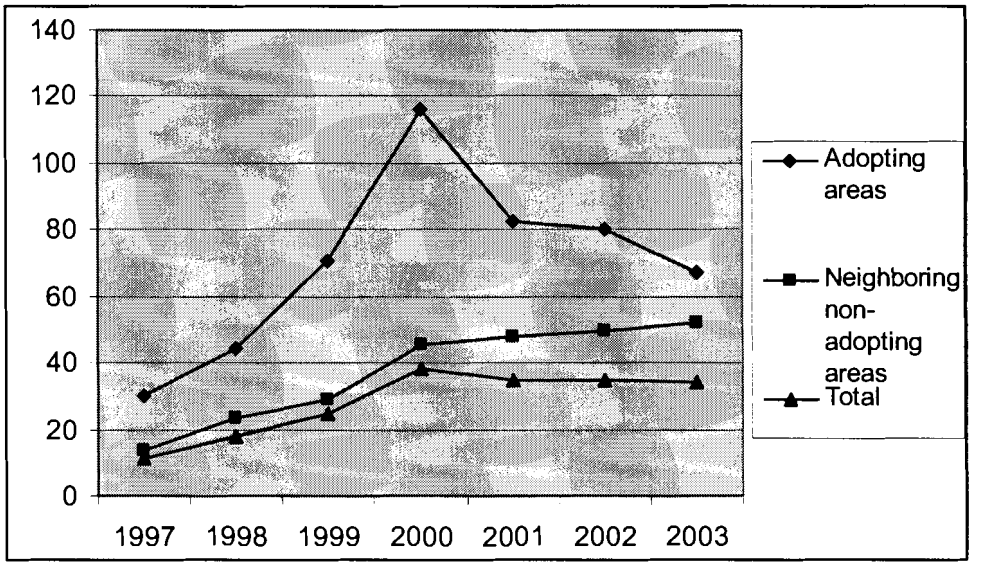
in local demand for marijuana. Perhaps education programs reduced the number of people consuming marijuana. Alternatively, users may have substituted other narcotics in place of marijuana.

Table 5.1: Mean Annual Grow Operations 1997-2003, by Area Type

Area	1997	1998	1999	2000	2001	2002	2003
Adopting areas	29.8	44.4	70.3	115.8	82.3	80.2	67.1
	(31.9)	(43.0)	(75.4)	(156.7)	(97.3)	(101.6)	(71.9)
Neighboring non-adopting areas	13.9	23.1	28.5	45.5	47.9	49.4	51.8
	(21.1)	(41.1)	(50.6)	(94.6)	(86.3)	(88.5)	(92.5)
Total	11.6	18.2	24.6	38.0	35.0	34.8	33.9
	(20.1)	(33.4)	(47.3)	(90.0)	(69.7)	(71.5)	(67.3)

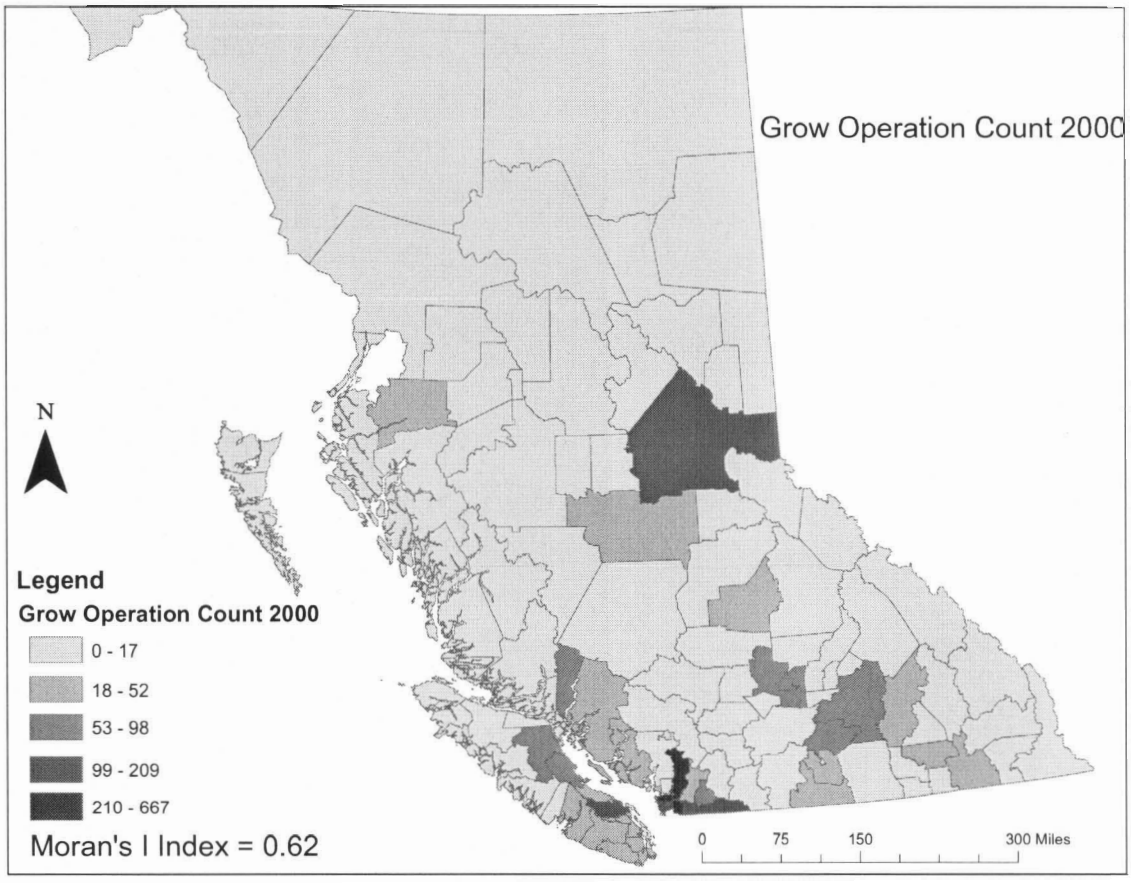
Note: Values in parentheses are standard deviations

Figure 5.3: Mean Annual Grow Operations 1997-2003, by Area Type



As noted above, it was not possible to construct a suitable counterfactual test using statistical matches (i.e. "propensity scores") that would have helped rule out whether the treatment effect was real, or simply the result of other place-specific characteristics (e.g., population, policing size, wealth). Creating a comparison group based upon simple contiguity aids us in overcoming this potential problem. As Grogger (2002) argues, places that are closer together are more likely to be more homogeneous in terms of demographic and economic factors that might influence levels of criminal activity. The spatial distribution of annual counts of grow operations by jurisdictions were also examined. Global measures of spatial dependence help to explore spatial associations in the distribution of some phenomena. Positive associations exist when neighboring locations share similar levels of a variable: for example, clusters of high (or low) values in geographically proximate locations. The association is negative when neighboring locations are dissimilar, with high-level locations adjacent to low-level neighbors. One of the most commonly used measures of global spatial association is Moran's I, a statistic that measures the extent of similarity or dissimilarity in a variable across neighboring spatial units. As demonstrated in Figure 5.4, the global Moran's I = .62 ($p \leq .001$ in two-tailed test) for the total count of grow operations in 2000. A positive Moran's I indicates that jurisdictions with similar numbers of operations are reasonably spatially clustered across BC. This is important because levels of activity should be similar across both the treatment and control areas.

Figure 5.4: Spatial Distribution of Grow Operations 2000



5.5.1 Estimating the Impact of Grow Teams on Grow Operations

Difference-in-difference estimates are used to compare changes in the level of reported grow operations before and after the adoption of specific policies in jurisdictions that initiated green teams (treatment) with neighboring jurisdictions that chose another policy (controls). Figure 5.5 maps the change in grow operation pre- and post-treatment, and Figure 5.6 maps the % change in grow operations post-treatment in relation to policies adopted in the high population area of the province.

Figure 5.5: Change in Grow Operations

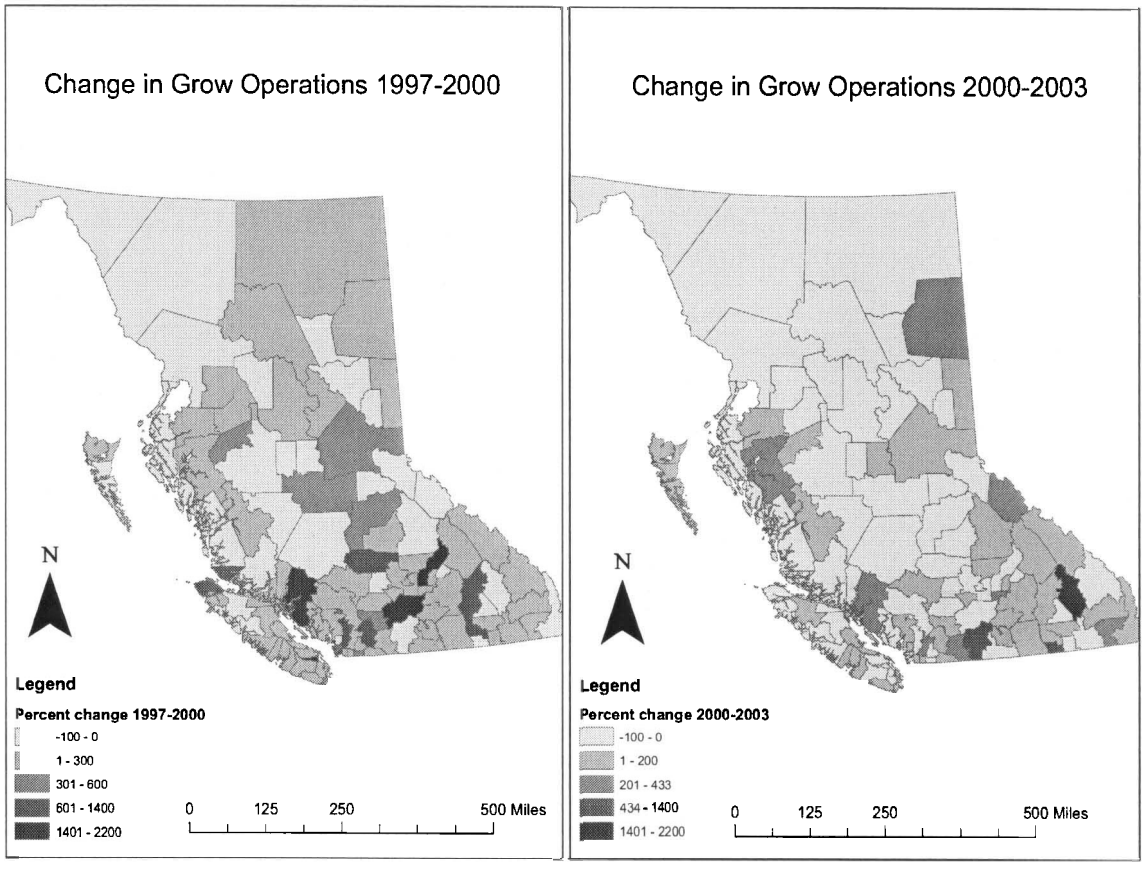
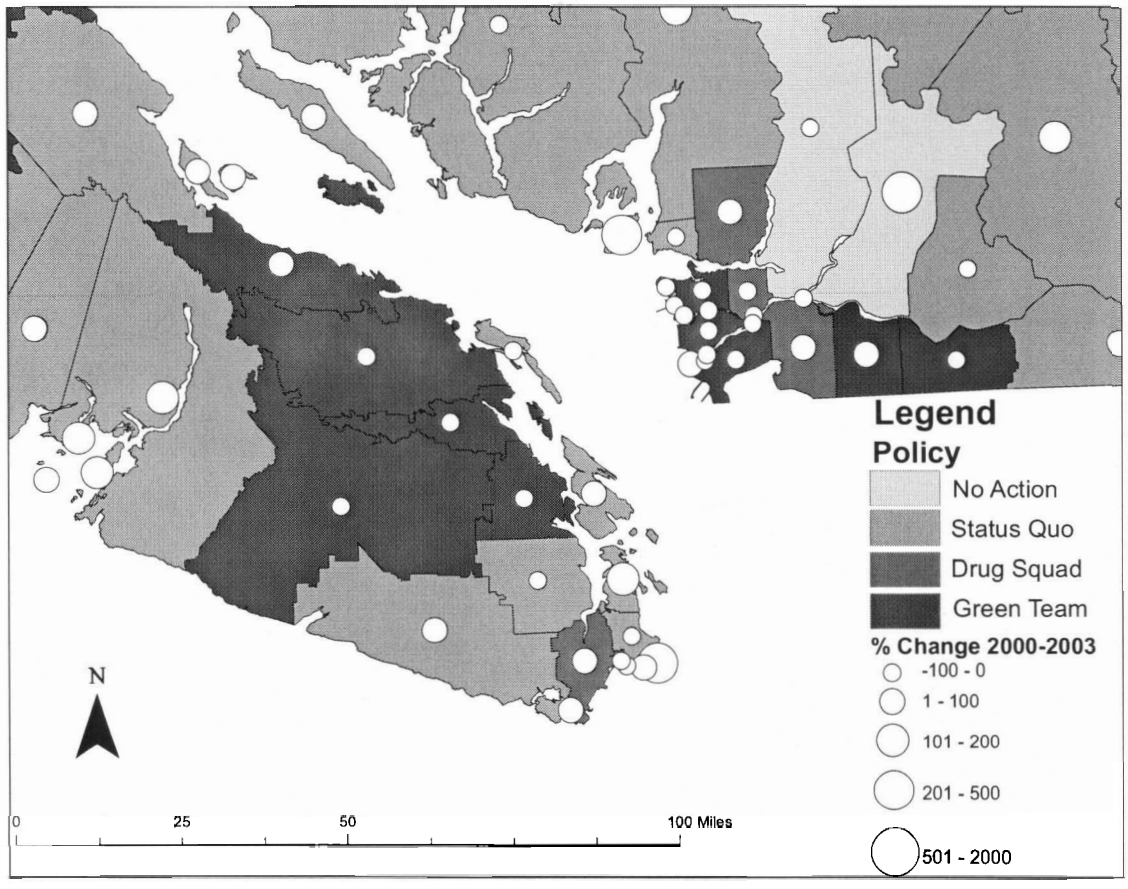


Figure 5.6: Change in Grow Operations 2000-2003 and Jurisdiction Policies in the High Population Area of BC



An OLS regression of the change in average growth rate regressed on a set of dummy variables can be used to determine whether any of the pre- to post-adoption differences between the treatment and control jurisdictions are significant. The following model is estimated for the entire sample of adopting jurisdictions (n = 18) and the non-adopting neighboring jurisdictions (n = 47):

$$\Delta G_i = \delta_0 + \delta_1 NONGREEN\_POST_{it} + \delta_2 GREEN\_PRE_{it} + \delta_3 GREEN\_POST_{it} + \varepsilon_{it}$$

Equation 1: Estimation model for adopting jurisdictions

where, $\Delta G_{i\,t}$ is the change in the average growth rate of marijuana production in jurisdiction *i* for the "pre" (1997-2000) and "post" (2001-2003) policy adoption time frame. By definition, the control jurisdictions do not adopt green teams. The dummy variable *NONGREEN_POST* captures the growth rate for the control jurisdictions and is coded 1 for 2001 (the year after all places adopted a particular policy) and the remaining years. *GREEN_PRE* captures changes in the treatment areas and is a dummy variable equal to 1 for the years 1997-2000 and 0 otherwise, and *GREEN_POST* is a dummy variable equal to 1 for the treatment jurisdictions in the years 2001-2003. ε_{it} is the random error term.

Control jurisdictions prior for the years 1997-2000 are the omitted category in the estimation of Equation 1. Therefore, the coefficient on *NONGREEN_POST*, δ_1, represents the pre- to post-adoption change in the growth rates of marijuana production for the control jurisdictions. The change in growth rates of treatment jurisdictions is calculated as (δ_3 - δ_2). The difference in these two changes, (δ_3 - δ_2)- δ_1, is the difference-in-difference estimate.

5.6 Results

The difference-in-difference analysis compares the difference between the change (difference) in pre-adoption to post-adoption growth rates in marijuana production in treatment jurisdictions to the same changes in the control areas.

For example, the growth rate of the number of grow operations was 0.26 (twenty six percent) for the treatment jurisdictions prior to the policy adoption. After the implementation of the teams, the growth rate reversed and declined at a rate of -0.56. Therefore, the difference in pre- to post-adoption growth rates for the grow team areas was –0.82. For the neighboring control areas, the growth rate fell from a pre-adoption rate of 0.40 to a post-adoption rate of 0.07, for a difference of –0.33. As expected, the drop in growth rates was larger in the jurisdictions that adopted green teams. The difference-in-difference estimate, therefore, is –0.82 – (-0.33) = -0.49.

To determine whether this difference in the growth rate differences is statistically significant, an OLS regression of Equation 1 is estimated. The difference-in-difference estimate is the combination of coefficients $(\hat{\delta}_3 - \hat{\delta}_2) - \hat{\delta}_1$. To test whether the difference-in-difference estimate was significant, a Wald test is conducted. Formally, I test whether $(\hat{\delta}_3 - \hat{\delta}_2) - \hat{\delta}_1 = 0$. With a p-value of 0.017, the result of the Wald test indicates that the difference in growth rates between the adopting jurisdictions and neighboring jurisdictions is indeed statistically significant.

5.7 Discussion

Based on 7 years of marijuana production data from every police jurisdiction in BC, the estimates presented above indicate that tactical units, such as green teams, decrease grow operations within their target area. Compared to the rate of increase in the period preceding green team implementation, the

treatment jurisdictions experienced an 82 percent decline in marijuana cultivation. This decrease begins within the first year of their introduction. Neighboring control areas experienced a seven percent increase in grow operations post-treatment.

Though the results are consistent with a theory in which more effective grow team investigation is leading to displacement into neighboring jurisdictions, one can not say that this is occurring with any certainty. This research reaffirms previous research that suggests displacement seldom occurs at 100 percent. The problem usually decreases even as it shifts (M. S. Scott, 2003). Though marijuana grow operations continued to increase among the neighbors, the rate of increase at least slowed compared to the pre-treatment rate (33% decline in growth rate pre- to post-treatment). Similarly, without access to more micro-level data on the decision making processes of grow operators, there is no way of knowing whether the slowing of growth represents a positive externality by way of the diffusion of the benefit of grow team adoption in adjoining areas. Clearly, however, the payoff of adopting a targeted intervention in the face of unchecked growth of grow operations far outweighs the benefits of doing nothing.

A second set of analysis that was identical to the above analysis except that we dropped from the control group those neighboring jurisdictions that had a "drug squad" policy was also conducted. Not surprisingly, the impact of green teams was somewhat accentuated (diff-n-diff = -0.56, Wald test = 0.036) when neighboring jurisdictions that took some form of a punitive, aggressive stance against drugs, in general, were excluded from the analysis. This suggests that

drug squads were also effective against marijuana grow operations, and supports a clear finding that when faced with growing levels of marijuana production, "doing something" clearly outweighs the option of doing nothing and maintaining the status quo. Similarly, adopting policies aimed at disrupting local grow operations reduced the operation levels in comparison to activity levels within jurisdictions that chose to reduce the level of enforcement/ prosecution.

This chapter provides another example that outlines the important reasons for considering displacement effects in the evaluation of locally targeted policy interventions, particularly crime prevention policy. In order to counteract displacement, it is critical to understand why displacement might occur and develop measures to track whether or not the problem is moving. Geographic information systems are a key tool in identifying displacement and the effectiveness of crime prevention policies. By using GIS to identify treatment areas and their neighbors, we were able to show that green teams are an effective place-based intervention that appears to reduce the level of marijuana production in the target jurisdictions without displacing activities to neighboring jurisdictions.

6 INVOLVEMENT OF ORGANIZED CRIME IN MARIJUANA GROWING OPERATIONS IN BRITISH COLUMBIA

6.1 Introduction

The topic of organized crime has challenged academics and criminal justice practitioners alike for many years. Published research on organized crime replicates the anecdotal reports of police investigators, which characterize many organizations as inherently complex. Officers often note that tracking (and prosecuting) members of organized crime groups is difficult primarily due to the lack of concrete linkages between suspected associates, known associates and the key individuals who are thought to 'broker' relations between constellations of other criminal networks or subgroups. Linkage analysis—the linear tracking of associates—whether in an informal set of hardcopy investigator files or notes, or in a structured, electronic suspect database, is currently the most common mode of information gathering and management. However, linkage databases are limited by their inability to efficiently capture the inherent qualities (nature) of these links; typically, all that can be noted in such a system is the fact that objects (suspects) are linked in some way. True social network analysis databases, on the otherhand, capture the specifics of the relationship itself as the primary unit of analysis—that is its nature, structure, strength and so on. The research presented in this study makes use of the latter technique. While academic research often prefers to conduct true social network analysis

wherever possible, the simplicity (and popularity) of linkage analysis cannot be overlooked entirely. Fortunately, linkage data can be adapted—not without significant effort—into more fully rounded social network data. In terms of policy and practice, it is much preferred that linkage data be kept as a baseline, and should further inquiry prove warranted, then additional efforts can be made to develop more extensive datasets for special purposes. Tracking criminal organizations is one such purpose, and one issue that lends itself particularly well to marijuana production in Canada, and particularly its most westerly province.

As indicated in the previous chapter, the number and rate of grow ops coming to the attention of police in the province of British Columbia has risen dramatically since the mid 1990s. In addition to becoming more noticeable, it appears that they are becoming more sophisticated than has been recently understood. With this increase in number and sophistication, law enforcement personnel and policy makers fear that organized crime is becoming progressively more involved in these cultivation operations. This chapter discusses the results of the methodology presented in chapter three to apply social network analysis to organized crime's involvement with marijuana growing operations. The purpose of this analysis is three-fold. Initially, the criminal network is described using a specially developed social network analysis database. Then several social network and spatial analysis techniques are combined to study the distances travelled from associate to associate within the network. Finally, the results are

presented and prospects for supporting intelligence-led policing policy are discussed.

The analytic techniques used in this chapter rely on several underlying theories and bodies of research. To assist in describing the composition and structure of social ties between known criminal associates, research on illicit criminal networks is reviewed. The "journey-to-associates" analysis is guided by the principles of a stream of research on the spatio-temporal ordering of crime events, a research orientation known generally as environmental criminology. Routine activities and crime pattern theories—two influential aspects of this approach—also offer theoretical insights into the typical spatial relationships between each associate, and offers a set of empirical methods for measuring their effects. Such techniques include calculating various measures of spatial proximity (such as Manhattan or simple Euclidean distances) and computational methods to model, simulate, or in some cases, predict likely travel paths between key offender activity nodes, which are measured here as place of residence, offence location, or the residence of known associates. Journey to crime research has generally confirmed the early predictions of Brantingham and Brantingham (1984c), that, all else being equal, offenders tend to exploit nearer targets more readily than those farther away from his (or her) residence, node, or assumed starting point. This literature further outlines an expectation that there will be a characteristic buffer zone of relative inactivity for the area immediately surrounding the offender's residence (or node).

This chapter begins with an introduction to the characteristics of organized crime and illicit drugs production before linking the discussion to the field of journey to crime. The journey to crime literature is reviewed to provide a theoretical basis for the analysis of distances from associates in a criminal network. The data for the study area are then discussed, and the findings are presented. The chapter concludes with a comment on how the results direct intelligence-led policing policies.

6.2 Organized Crime and Illicit Drug Production

Following Kleemans and Bunt (1999), this research focuses on criminal associations rather than criminal organizations, and is more directly concerned with relationships between individuals than the organization itself. Focusing on the attributes of known associations (such as type, quality, and strength) has the added benefit of highlighting possible interactions with other variables suggested by the geographic study of crime events.

Organized crime is thought to be responsible for trade measured in billions of dollars annually. In the latest study of gangs and organized criminal groups in British Columbia found that that Vietnamese comprised the single largest ethic group (at nearly 20%) of their sample of 178 criminally-involved persons (Gordon, 1994). Just over one-half (57%) described themselves as a visible minority and a similar proportion had "difficulties" with the English language. Gordon and the Greater Vancouver Gang Study research team identified that visible minorities tended to also be disproportionately from more modest socio-economic backgrounds and were more likely than their non-visible minority

counterparts to be part of a collective criminal entity (Gordon, 1994). Gordon also suggests that the economic opportunities presented to recent immigrants are a likely contributor to successful recruiting for criminal organizations. These findings seem to point to the tendency for some, particularly young adult males, to become involved in criminal associations—something which is also true of suspects in the present study, as will be seen below. In policy terms, such findings indicate that any meaningful reductions of organized crime activity in the province will have to be coupled with an equally meaningful improvement in economic opportunities. Apart from noting the composition of criminally involved group members, the Greater Vancouver Gang study also considers the process of such groups blending legitimate business concerns with ever more illegitimate ones. Frauds, extortion, trafficking in humans, stolen property, and of course, drugs, are primary examples (Gordon, 1994). While marijuana production was not directly discussed, the economic benefits of this activity are clear, relatively easy to coordinate, and can, in most cases, be completed with minimal risk of discovery by criminal justice authorities.

A British Columbian economics expert suggests that approximately 3,000 grows are discovered each year by police out of an estimated 17,500 (estimates for the year 2000)--a rate of just under 1 in five—which is consistent with ratios suggested by police officer discussions throughout the data collection process (Easton, 2004). Easton also suggests that for even modestly sized growing operations (of 100 plants), nearly CAD $80,000 of marijuana can be produced and sold in 1kg blocks, based on four grow cycles of about $20,000 per year.

With costs included, Easton estimates that the grow operation will return approximately 55% on investment (Easton, 2004). Expertise in initial setup, like in any business, is extremely helpful, but largely is not necessary to make a profit. Internet sites abound that show interested persons how to arrange growing cycles, lighting schedules, and other tips for becoming a genuine "green thumb".[18] One would expect that as experience levels grow, so too do profit margins.

Aside from the obvious economic motive for criminal organizations being involved with the production of marijuana is a business practice that fits into what researchers describe as economically-based criminal associations. McIllwain describes many such organizations as part of the "enterprise paradigm" (McIllwain, 1999). Business/economic motives form the basis of such groupings, and this characteristic is more accurate than the stereotypical assumption of many (including academics and criminal justice officials) that criminal organizations are characterized by local geography, ethnicity and violence. Another misunderstanding concerning criminal organizations is their supposedly rigid, hierarchical structure.

6.3 From *Journey to Crime* to *Journey to Associates*

The research base surrounding the journey to crime arose from Pattern Theory and other interconnected tenets of Environmental Criminology (Brantingham & Brantingham, 1978) to test whether a criminal event can be

[18] See URL Ref: http://marijuanaworld.com/MarijuanaLinks.htm#Cultivation%20Links [accessed 17 May 2006]. This "cultivation" links page points to more than two dozen resources, strategies and howtos.

understood in the context of people's normal movements through their routine activities. The theoretical focus was on how crime happens in specific locations and at specific points in time, with particular attention paid to the offender's movements to and from the criminal event. It was acknowledged that these movements were dictated by an offender's own personal awareness space, which often formed during their legitimate activities and non-criminal movements to and from primary activity nodes. While assessing the rational choices made by offenders to move to a particular location to commit an offence, and the routine activities that brought that location to the attention of the offender, the possibility was forwarded of forecasting crime placement and distribution in space and time.

Journey to Crime research aims to develop this predictive capability, and has found that the distance travelled and the direction of the journey are highly predictable. This in turn has led to pragmatic approaches, such as the ability to spatially profile an offender's residence or similar anchor point by using crime occurrences (Brantingham & Brantingham, 1978; Brantingham & Brantingham, 1984a; Brantingham & Brantingham, 1991; Brantingham & Brantingham, 1991). Research on Journey to Crime is based on elements from three separate, yet interconnected, theories: Rational Choice, Routine Activities and Pattern Theory. Each is discussed in turn in the next section.

6.3.1 Rational Choice, Routine Activities and Pattern Theory

The premise of Rational Choice Theory is that offenders will embark upon offending behaviour through a structured decision-making process which seeks

out the maximum benefit for the minimum amount of risk. In this way, offenders are seen as active in this decision-making process, and will use environmental, social and cognitive cues at their disposal to aid in their decision making. While the decision to offend is considered a rational choice, it is, nevertheless, constrained by a number of situational and physical dimensions: time, activities, the structural environment, and social situations. Therefore, analysis of offending must take into account this rational decision making process at each step along the path to offending. Concern must not be limited simply to the choice to offend, nor the target selection, as many other factors may be involved which will determine whether the offender continues the offence or desists following a change in their environment, situation or determination of risk (Cornish, 1993; Cornish & Clarke, 1986).

The Routine Activity approach primarily focuses on the elements of the criminal event, and the 'chemistry' of elements that are necessary for that event to occur. Criminal acts have three necessary elements; namely, the presence of a motivated offender, a suitable target and the absence of capable guardians against the offence (Cohen & Felson, 1979) Routine Activities Theory may be compatible on some levels with Gottfredson and Hirschi's (Gottfredson & Hirschi, 1990) theory of low self-control and Rational Choice theory (Cornish, 1993; Cornish & Clarke, 1986). Felson argues that anything that makes crime harder to commit also makes it less likely to occur (Felson, 1986). Rational Choice theory asserts that these limits on opportunity are 'costs' that reduce the 'expected utility' of crime. From a self-control perspective, making crime harder

to commit makes it less immediately gratifying. These perspectives share with routine activity theory the view that, in any situation where a crime event could transpire, the decision to offend will be influenced by the ease or difficulty with which the offender's search for gratification can be satisfied (Lilly, Cullen, & Ball, 2001)

Pattern Theory focuses on how crime happens in specific locations and at specific points in time. While focusing on the place of the criminal event, special attention is also paid to the offender and victim's place in time, their travel to and from the event, and their awareness spaces that brought them into contact with each other. The criminal event can be understood in the context of people's normal movements through their everyday lives, which will vary depending on the time of day, day of week and month of year or season. There is a recognition that it is more often normal, legitimate activities of the victim and offender which shape crime patterns. Pattern Theory can be seen to integrate new concepts with those forwarded by Rational Choice Theory and Routine Activities Theory (Brantingham & Brantingham, 1978; Brantingham & Brantingham, 1984a; Brantingham & Brantingham, 1991), and will be further illustrated in the discussion of the research looking at the Journey to Crime.

6.3.2 Basic Tenets

6.3.2.1 Crime Trips are Relatively Short

The primary proposition that the majority of crime trips are relatively short is well documented in the literature (Brantingham & Brantingham, 1991; Eck & Weisburd, 1995; Fritzon, 2000; Rengert, 1992; Sorenson, 2005; Warren et al.,

1998; Wiles & Costello, 2000). This proposition is closely based on the distance decay model, which asserts that individual's interactions with other people and places decrease as the distance between them increases (Brantingham & Brantingham, 1991). This further expands into the recognition that the development of each individual's awareness space is the primary determinant of offending locations and is also influenced by distance decay. Due to this model, it is more likely to see a clustering of offending around a particular offender's home than a random distribution across a vast distance (Brantingham & Brantingham, 1991).

However, distance and travel are not always the same thing to all people. The perceived distance is often quite different from the actual distance. Better known locations tend to be estimated as closer, while those that are unknown tend to be estimated as being much farther away (Brantingham & Brantingham, 1991). Estimating distance and travel is also highly dependent upon the type of street, whether it is a major or minor road, and the speed that one can travel upon it. Distance is also highly dependent upon the mode of travel, as the routes and travel times of an individual riding public transit may be very different from someone travelling by car or bicycle (Brantingham, Brantingham, & Wong, 1991). These recognitions also lead back to the development of awareness spaces, as our choice of route and mode of transport will also determine what we see, how often we see it, and how familiar we become with the detail within it. An individual riding a rural route on a bicycle will develop a very different awareness

space than an individual who accesses an area via a major highway that is separate from many residential areas (Brantingham & Brantingham, 1984b).

6.3.2.2 Crimes Cluster Around the Home

Closely tied to the first proposition is that more often than not, crime tends to cluster around an offender's home (Brantingham & Brantingham, 1991). This is based primarily on the social psychology approach, which advocates the human preference for the familiar, and is also supported by the distance decay model (Brantingham & Brantingham, 1991; Rhodes & Conly, 1991). This approach recognizes that individuals generally feel uncomfortable navigating through unfamiliar territory. This holds true as well for offenders, as their willingness to commit offences in unknown territory is often diminished (Ratcliffe, in press; Sorenson, 2005). Due to the rational decision making process involved in the commission of an offence, the determinations of good targets as well as entrance and exit routes are highly dependent upon intimate knowledge of an area. This is generally supported by the idea that the risk of detection and capture increases in unknown areas due to the lack of information regarding the ease of locating and obtain the target and the ease of escape (Brantingham & Brantingham, 1978; Paul J. Brantingham & Patricia L. Brantingham, 1991; Brantingham & Brantingham, 1991).

6.3.2.3 Existence of a Buffer Zone

The final primary proposition of the journey to crime is in some ways a caveat to the second proposition. Although it is well established that the majority

of crimes occur within a close vicinity to the offender's home or other major activity nodes, there is a second phenomenon that has been proposed – the presence of a buffer zone. While insiders may be more knowledgeable about an area and therefore, theoretically more prone to offend there, their visibility by other members of a community may hinder their efforts. Likewise for those who are outsiders, whereby their presence is immediately known by those residing in a community who have a strong sense of territoriality (Brantingham & Brantingham, 1993b). Therefore, the distance decay model is typically modified to include this "dip" or decrease in activities in the immediate area surrounding the offender's home. However, as with all research, there are apparent exceptions or instances where these propositions do not appear to hold. When examining the utility of new geographic profiling techniques, the proposed buffer zone was not found to be present; however, the majority of offences were still found in close proximity to the offender's home (Kent, Leitner, & Curtis, in press).

Along with the three primary propositions, the journey to crime research has illustrated several caveats or refinements to the broad statements. These include recognitions that journeys tend to vary with the type of crime being committed, and the demographics of the individuals committing them.

6.3.3 Defining Characteristics

6.3.3.1 Type of Crime

Early on in the literature, it was proposed that the crime trip distance would depend on the type of crime being committed (Brantingham & Brantingham, 1978; Rhodes & Conly, 1991). Those committing affective crimes

such as rape, which satisfy immediate gratification, were proposed to travel shorter distances. Consequently, those who committed instrumental crimes such as burglary, which involved delayed gratification, would travel longer distances to locate and offend against a target (Brantingham & Brantingham, 1978). This distinction between the type of crime and the distance travelled was proposed to be a function of the multi-staged decision process the offender goes through to identify a target or victim. The distance travelled may be an extension of this decision process. For instance, the decision to commit a crime with a high-affect motivation may involve a minimal number of stages, and therefore, involve a shorter journey to crime. Conversely, more instrumental crimes were proposed to require a much more careful search process, which may necessitate a longer journey to crime (Brantingham & Brantingham, 1978; Brantingham & Brantingham, 1993a). This has been supported in the literature with respect to both types of offence, and motivational differences between offenders. When examining the motivational influences on journeys to crime, it was found that property offenders indeed travel further to their offence locations than violent offenders: the average journey for a rapist was 1.15 miles, while the average journey for a robber was 2.1 miles (Rhodes & Conly, 1991). Similarly, it was found that arsonists who had a high affect motivation for committing their offences traveled further than those arsonists whose motivation was far more emotional in nature (Fritzon, 2000).

6.3.3.2 Type of Offender

In a similar vein, it also appears that the typology of the offender may contribute to the length of the journey. The most prolific burglary offenders, those who committed 20 or more offences, were found to travel much shorter distances than a one-time or casual burglary (Wiles & Costello, 2000). This may be due to the increased offending activity, which may directly support many theories concerning the recognition that offending can only happen during discretionary time along normal travel routes. Using this, it would make sense that those offenders who commit numerous offences will have less discretionary time and may therefore choose targets much closer to home in order to maximize the efficiency of their offending. However, there is some evidence that suggests this willingness to travel is more appropriately linked to burglar experience, not the volume of their offences. Older, more professional burglars appeared more willing to travel into unknown territory than younger, less professional burglars (Brantingham & Brantingham, 1984).

6.3.3.3 Demographics of the Offender

Another recognition is that travel distances seem to vary with age and gender, which supports the earlier proposition that the awareness space, and therefore the 'crime template' of offenders should vary with age and the distribution spatially of their activities, and with the urban makeup of their environment (Brantingham & Brantingham, 1978; Rhodes & Conly, 1991). The age relationship often equates to a finding that older offenders tend to travel farther than younger offenders to commit offences (Nichols, 1980). However,

other research has refined this trend to recognize that the age-journey relationship may in fact be more akin to an inverted U-curve, where the very young and very old offenders travel shorter distances than youth and adults (Fritzon, 2000; Sorenson, 2005). Despite variations in their findings of the relationship of age to distance travelled, both researchers found a negative association with gender and the journey to crime insofar as females appeared to travel much shorter distances than males to commit offences. However, with extremely small numbers of female offenders within their research data, this association may not be as robust as purported.

6.3.3.4 Alternate Anchor Points

Anchor points can include work, home or school (Rengert, 1992), and an offender's choice of anchor point may also vary according to their age and routine activities. For instance, in keeping with the notion that offending patterns are committed during non-obligatory times, school-age children may use their school or friend's house as an anchor point for offending after school before there are due home. In a similar vein, opportunity structures may also determine the length of the journey, as neighbourhoods with limited viable opportunities for offending will likely see their resident offenders travelling farther to neighbourhoods where the opportunities are more plentiful (Hesseling, 1992). In an effort to characterize different journeys and alternate anchor points, a typology was developed in the early 1990s when analyzing serial rape (Canter & Larkin, 1993). It was hypothesized that there would be two general models for serial rapists. The first being the *Commuter Model*, where the offender travels away

from home to offend. In this model, the offender's 'criminal range' may be independent from home base and generally farther from it. The second model was termed the *Marauder Model*, which assumed a relationship with home and offending and hypothesized that offending would follow a random pattern from home to commit crime. However, more often than not, journey to crime estimates are based on the offender's home location. Research has cautioned that this may run the risk of either underestimating the journey to crime due to a higher likelihood of those offending near home being caught (Eck & Weisburd, 1995), or by overestimating the journey by ignoring the presence of alternate anchor points. The overestimation is often due to the number of offenders who use the home address of a friend as a more common anchor point for criminal journeys (Wiles & Costello, 2000); therefore, estimates should concede that alternate anchor points may produce different journey distances.

6.3.4 New Directions

6.3.4.1 Directional Bias

The examination of the journey to crime involves the assessment of both distance and direction (Eck & Weisburd, 1995). In an innovative approach, Rengert and Wasilchick (2000) incorporated both distance and direction when analyzing their group of 32 burglars. Using a baseline of the direction from the offenders' homes to their workplaces, they examined the change in angle to each burglary site. Their findings demonstrated that the offenders showed a clear tendency to offend in areas within a close distance to the path from home to work, and there was little deviation into areas that were over 45 degrees from the

baseline direction. These findings support propositions of both Routine Activities Theory and Pattern Theory, as there is a clear preference for areas within the offender's awareness space and a dedication to the least effort principle (Rengert& Wasilchick, 2000). The tendency of offenders to avoid delving into areas off the offender's main path may also demonstrate their preference not only for the convenient, but also for the familiar. This may point to new directions in the examination of the journey to crime, as the unwillingness to offend in an area may be due not only to an unfamiliarity with that area, but an inability to become familiar with areas outside of the current awareness space due to temporal constraints.

6.3.4.2 Temporal Constraint

Both Rational Choice Theory and Pattern Theory have acknowledged the importance of discretionary time on offending patterns and the development of awareness spaces and crime templates (Brantingham & Brantingham, 1984a; Cornish & Clarke, 1986). While these temporal constraints and the location of offender nodes can be seen as a prime determinant of patterns of offending, the relative risk to any one target may not be fixed and continuous. The temporal constraint placed on an offender implies that the risk that the individual poses to a particular target is often brief and dynamic, and although may be fairly regular, often lasts only briefly each day (Ratcliffe, in press). As an offender passes through an area during the course of his routine activities, the opportunity to both locate a target and offend against that target is temporally constrained by the need to participate in an obligatory activity such as work. If an offender only has

a few minutes of discretionary time on the way to an obligatory event, it is likely that targets will be located close to the travel path the offender is on, and will not deviate substantially from the general route. In this way, each target along the route is only at risk for a few brief moments in time, as the offender must budget his time in order to arrive at his destination within the desire timeframe. However, this theory recognizes that this dynamic risk to targets will likely be for longer periods of time when the offender is not constrained by obligatory events. If the travel route or routine activity is the result of non-obligatory events, the offender's time budget is far more malleable and fluid. This may leave more targets at risk for longer periods of time and increase the spatial risk as well along the travel route.

However, this may not necessarily mean that the offender will always delve into unknown territory when not constrained by obligatory events. As the average speed of the offender likely slows in unfamiliar territory due to the necessity to become more active in wayfinding, less ground is able to be covered in a similar amount of time (Ratcliffe, in press). Building on Rengert and Wasilchick's (2000) directional bias, Ratcliffe (in press) proposes that any journey that deviates from the chosen routine direction by an offender will erode the available time for offending due to this increased need for wayfinding and the inefficiency of having to double-back to re-establish the chosen route.

While trips between associates are theoretically similar to what is known about "crime trips," it is important to recognize that they are not necessarily identical to classic journey to crime travel paths. One cannot assume that

associate to associate distances, route selection, or agent awareness of any observed immediate surrounds are the same as when these situations are encountered as a trip to crime. Nevertheless, it is reasonable to consider it as structurally analogous or representative of movements amongst individuals in a criminal network. A second concern is raised by the critics of geographic profiling. The nature of this reservation is the observation that an offender's trips may not always originate from home but rather from friend's or associate's home. This is a valid concern, but one that speaks more to precision of locational measurements between specific individuals, something that associate-to-associate journeys need not claim in order to be a good predictor of aggregate movements of many individuals over time. The strength of the activity and awareness space concepts is that they stand for knowledge areas rather than literal travel paths or movement vectors. "Fuzzy" addresses (or imprecise last known residences) are a constant problem for criminal justice datasets. Recognizing that the current data are subject to the limitations of address *precision*, it is still possible to maintain that these locations, even if stale, still possess an *accuracy* of suspect knowledge areas and consequently an idea of the distances to which associates will move about in patches of space.

Knowing something of the likely distances travelled among associates is helpful for understanding criminal organizations in both theoretical and practical terms. In terms of theory, exploring the spatial distribution of known associates assists in the testing of the major tenets of routine activities theory and pattern theory. If, as both theories would expect, associates will operate (locate) and

then travel within areas with which they are familiar, we should see this clumping effect in location of suspects known to each other. Different types of associates (tenders of the grow versus owner/managers) will likely have different awareness spaces as a result of expected longer distances between associates. While these theoretical questions are considered in more detail (and in combination with the empirical findings) below, it should be mentioned that work is already underway that looks at further refining our understanding of actual travel vectors (paths) of criminally intending agents. Building on work first initiated by Brantingham and Brantingham in the 1970s (Brantingham & Brantingham, 1984c; Brantingham & Brantingham, 1991), the Institute for Canadian Urban Research Studies at Simon Fraser University is developing agent-based simulations of offender travel paths and decision-making algorithms for likely crime targets (TOPO/Mastermind).[19] Clearly there is an interest in further increasing the precision with which researchers can understand the movement of people involved in crime events within the built environment.

In practical terms, it is important to know about the distance between associates for a couple reasons. First, and most obviously, it is important to for law enforcement personnel to know where their suspects are for surveillance and or related tactical and strategic purposes. Beyond simply knowing where criminal associates live is the value of knowing the immediate areas wherein suspects can typically be found. Knowing something of the extents of likely nodes, one can then infer, again using the principles of environmental criminology, likely activity spaces. Crime prevention and reduction strategies

[19] See URL Ref: http://www.sfu.ca/icurs [accessed May 22, 2006].

could be brought to bear on likely targets within these areas or crime "niches", such that if an area is known to have several criminal associates residing in an area, police might chose to observe these locations more closely in order to understand the movements of people to and from these locations. A similar strategy would be to scan the immediate surrounds of known suspect residences or nodal activity points for the presence of marijuana or other clandestine drugs production facilities.

6.4 Organized crime and social networks

While criminologists have been interested in the impact or role of organized crime groups, criminal associations, street gangs in the U.S. (Tita et al., 2003a) or motorcycle gangs in Canada (Gordon, 1994), relatively little attention is focused on the specific nature of what connects these various groups. Social network analysis does just that, and puts into focus the quality of the ties that bind members together, whether they be loose or structured, hierarchical or linear (McGloin, 2005; McIllwain, 1999). It is important to note, however, that social network analysis (SNA) is quite different from a discussion of social bonds (Gottfredson & Hirschi, 1990), social cohesion (Bellair, 1997; Laub & Sampson, 1993; Sampson & Laub, 1990, 1993; Sampson & Raudenbush, 1999), or more the ethnographic and interview-based studies of gang membership (Gordon, 1996; Spergel, 1992). As will be seen below, work is underway in Europe (Sarnecki, 2001) and in North America that takes for its unit of analysis the nature of ties or relationships—rather than the agents themselves.

This truly social *network* approach can be seen in three categories of the research literature based on their linkage strategies. The first "generation" (Xu & Chen, 2005) is primarily a manual (by hand) linkage of members to one-another. Although this is seen as the primary investigative technique used in law enforcement currently, it has obvious limits, particularly when the membership is large. The second generation is advancement in that it automates visualization of linkages and allows basic queries to be made of its matrices or tables. This represents significant gains in analytical power and time savings to the investigator—at least once the data are collected and entered into machine-readable form. While Xu and Chen do not see any manifestations of the third generation of technology at present, they feel that "structural analysis approaches" will enable researchers to drill even further into the specific qualities of social ties themselves. Key among second (and what will be third) generation SNA techniques are measures of how cohesive (or decentralized) networks are. For criminal network applications, this is particularly important, as prevention and intervention techniques must be adapted to suit the structure of the network (McGloin, 2005).

Most police operations are geared towards "taking down" the head of crime syndicates, where the stereotypical crime boss is in complete charge. However, many criminal organizations, including those which specialize in illicit drugs distribution, appear to be less hierarchical or centralized in nature (McGloin, 2005; McIllwain, 1999). Decentralized groups, or "cells" have also become a recognized tactic in the intelligence and anti-terrorist community.

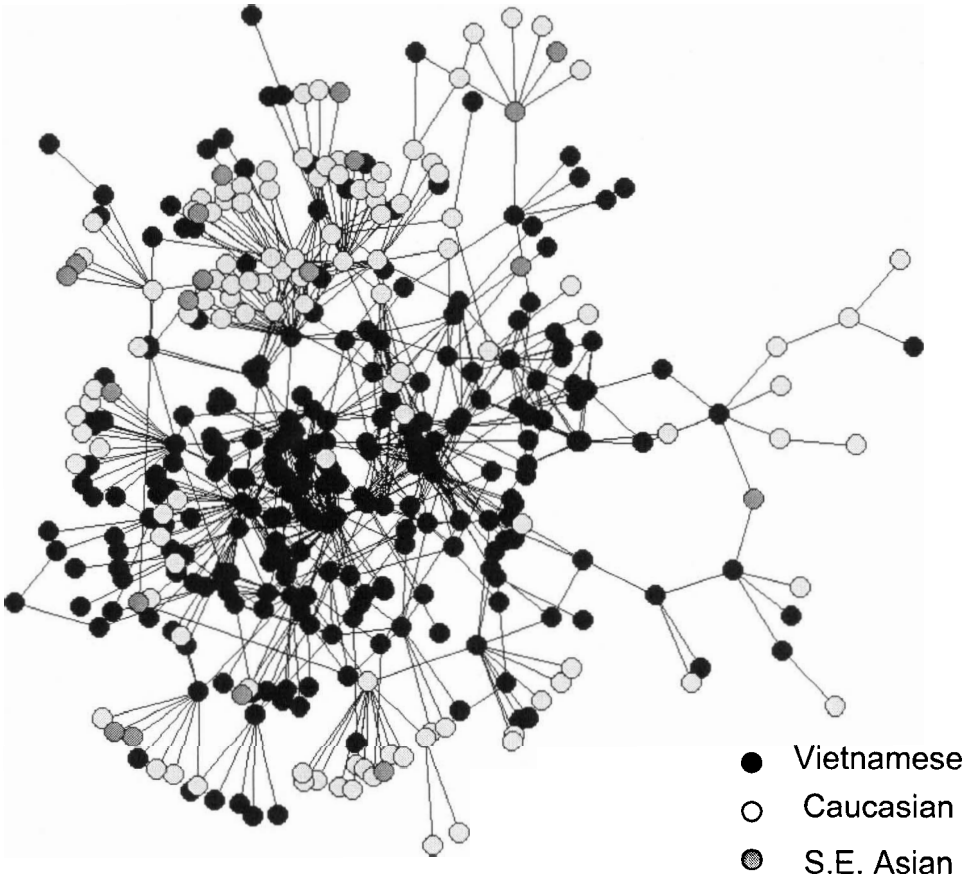
Counter-terrorism and tracking of terrorist cells has become increasingly prevalent in the post-September 11, 1999, western world. Recent work (Xue & Brown, 2003) has focused on the computational and analytical power afforded by data mining, knowledge discovery and social network analysis in the field of national security.

6.5 Data

Data on 376 individuals involved in an illicit drug production organized crime network in Vancouver, British Columbia were collected (see figure 6.1). The data were collected from the case files generated by the Vancouver Drug Unit, which identified both suspects and their associates who were known to operate multiple marijuana grow operations in the jurisdiction between 1997 and 2003. The primary members of the criminal network were identified by membership in a criminal organization, recognized through a common group name, sign, identifying characteristic, and an involvement in illicit drug production, particularly marijuana growing operations. In addition to capturing primary members of the drug production network, their associates were identified. In order to be classified a criminal associate of a primary member, the individuals must have co-offended together, be relatives, or be deemed criminally connected through source-based intelligence (wires, surveillance), or some combination of the categories. It is important to mention that not all co-offenders or family members are included in this data, only those also involved in the illicit drug trade. In this regard, our primary members were selected using the "positional" sampling approach and their associates were chosen using

"reputational" sampling approaches, as described by Scott (2000). The ties between individuals are symmetrical and undirected. In other words, the relationships are reciprocal – individuals co-offend with one another and/or they are family members with one another.

Figure 6.1: Drug Production Criminal Network



While the use of experiential knowledge of law enforcement personnel to inform criminal associations has been used in gang (Braga, Kennedy, Waring, & Piehl, 2001; McGloin, 2005; Tita et al., 2003a), and organized crime research (Morselli, 2006), there are many threats to validity and reliability associated with

this form of data collection that need to be addressed. The first issue is that of missing data. It is impossible to collect all of the possible nodes (individuals) and edges (ties between individuals) in a network without surveying the individuals involved. However, the hidden, illicit nature of criminal networks makes surveying participants ethically and practically unfeasible. The participants are unlikely to be forthcoming about the nature and frequency of their associations since revealing this information could have personal and business ramifications. The second issue deals with fuzzy network boundaries. When collecting data for social network analysis it is important to know what your network boundaries are. Due to the same issues mentioned above, it is impossible to ascertain accurate network boundaries in criminal networks. The researcher must make a decision as to where to set the network boundaries.

The incident, demographic, geographic and criminal history data were collected from a police records management system. If the individual was a suspect in a drug production file, as the majority of our primary members were, then the information on that incident was coded using a 32-item coding sheet (see Plecas et al. (2005) for coding sheets). Variables collected include size, location, and hazards of the operation. Demographic and criminal history information on each individual was collected from the police database. Demographic information collected included age, ethnicity, gender, citizenship, place of employment (if known) and last known home location. The criminal history variables included number, type, location and date of prior offence(s).

The spatial data were generated using ArcGIS and CrimeStat software packages. The last known address, incident location, and place of employment (if known) for each of the individuals in the network were geocoded in ArcGIS. Of the 376 individuals, 318 had last known addresses that were geocodable. The geocoded addresses were then imported into CrimeStat III software and a point to point distance matrix was created. This matrix contains the Euclidean distance between the last known address of the 318 individuals. The distance matrix was then imported into UCInet and using elementwise multiplication, the distance matrix was combined with the criminal network matrix. The result was a distance matrix between every individual tied within the network. The distance matrix was then transformed into spreadsheet format. This geographical database was then integrated with the incident, demographic and criminal history database and analyzed with statistical software.

6.6 Analysis and Results

6.6.1 Social Network Analysis

The density of a network is one indicator of group cohesion. The criminal network involved in marijuana production has 17,672 observations and the proportion of possible ties present, or the density of the network, is .008. In other words, the probability that there is a tie between two random actors is .8%. This is a very low density, but is similar to other studies conducted on incomplete criminal networks/gangs (see McGloin 2005). This density coefficient suggests that the criminal network involved in marijuana production is not tightly organized.

While the overall network is not tightly organized, there are cohesive subgroups that exist. Gang researchers have identified cliques of core members within larger networks that "essentially shape the nature, purpose, and activities of the larger group" (McGloin, 2005; I. Spergel et al., 1994). The cliques range in size from 3 to 12 persons.

In addition to cohesion and subgroup analysis, descriptive and inferential statistical techniques were used to summarize the network and illustrate the associations/patterns within the data. Statistics are especially appropriate for large networks like the drug production network in this chapter, where reliability issues are a concern (Hanneman & Riddle, 2005; Wasserman & Faust, 1994). Standard statistical tools used to describe differences and associations are appropriate for network analysis; however, standard statistics cannot be used for inferential questions where the observations are not independent (Hanneman & Riddle, 2005; Wasserman & Faust, 1994). To clarify what is meant by dependent observations, one case may be person A's tie to person B; and another case may be person A's tie to person C; and yet another person B's tie to person C. These are not independent observations because each individual is involved in two cases. Instead of standard inferential techniques, the interdependent observations seen in network analysis necessitate specialized statistics using "boot-strapping" or random permutation to generate accurate standard errors.

Statistics with random permutation were conducted to test whether gender and ethnicity had an effect on network centrality measures. The average normed

betweenness, degree, eigenvector, and closeness centrality of women are not significantly different than the normed average centrality measures of men. This suggests that gender does not influence network position and number of ties.

The differences among mean betweenness centrality among Vietnamese Caucasians and South Asians is significant ($F = 3.63$ with 2 d.f. and $p = .03$). However, the differences in group means account for only 2% of the total variance in betweenness centrality scores among the individuals in the criminal network. The differences between mean degree centrality across ethnicities was also significant ($F = 4.60$ with 2 d.f. and $p = .02$). Once again, the differences in group means for degree centrality account for only 2% of the total variance in degree centrality scores among the individuals in the criminal network. Ethnicity had the most significant impact on eigenvector centrality, with 7% of the total variance being accounted for ($F = 14.40$ with 2 d.f. and $p = .0004$). The differences between mean closeness centrality across ethnicities was not significant. It is hard to make any substantive comments on the effect of ethnicity on any of the centrality measures since so little of the variance is accounted for.

A common observations in social network analysis is that similar individuals are more likely to form social ties. The homophily hypothesis tests these observations by positing that in a network with different types of actors, the density of ties will be greater within each group than between groups. The organized crime network in this research did not conform to the homophily hypothesis across either ethnicity or gender. In other words, individuals of similar ethnicity and gender are not more likely to form ties in the drug production

network. A possible explanation for this in regard to ethnicity is that the predominant ethnicity, Vietnamese, have to make ties to other ethnicities, who also represent other organized crime units, in order to traffic the drug. The minority ethnicities, Caucasian and South Asian, are scattered around the network and must form ties with the Vietnamese (primarily producers) in order to obtain the drugs.

6.6.2 Integrating Social Network and Geographic Analysis in the Examination of Drug Production Networks

At the outset, 31% of the ties between associates had zero distances. In other words, 31% of the individuals who were criminally associated were living with one another. These distances were excluded from the analysis for the following reasons: (1) their inclusion would dramatically underestimate average distances, and (2) this analysis focuses on examining the distribution and correlates of the distances involved in the *journey-to-associates.* If associates live together there is no travel distance, thereby no *journey*. An additional five individuals were removed from the spatial data analysis as they involved addresses outside of the Vancouver Police jurisdiction. It was determined that due to problems inherent with jurisdictionally-based police data systems it was not pragmatic to extend the analytic framework to include long distance, inter-jurisdictional travel patterns. This left 95 egos with associations living within the local jurisdiction and outside of their last known residence. The 95 egos account for 531 edges.

Following journey-to-crime research, four distance variables were computed: mean, median, closest and farthest distance. As described by Warren et al. (1998), the closest distance is the distance from the ego to their closest associate and correspondingly, the farthest distance represents the longest distance between ego and alter. These distances are important as they (insert something about importance).

Table 6.1: Distances Travelled to Criminal Associates Involved in Drug Production

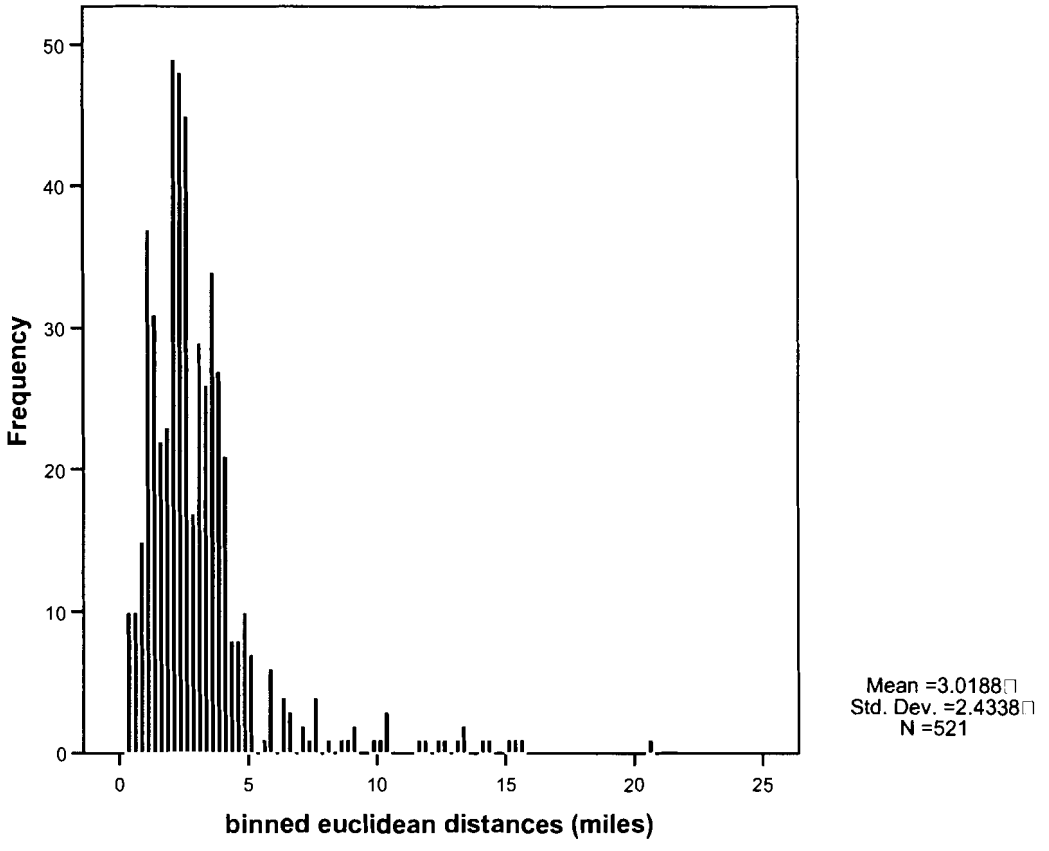
Distance measure	Mean	SD	Range
Closest distance	1.49	1.00	0.01-5.56
Mean distance	3.96	5.13	0.61-36.13
Farthest distance	8.06	8.06	0.61-40.11

N=95

6.6.2.1 Distance Decay in the Journey-to-Associates

This portion of the analysis mathematically describes the distances between associates in the criminal network. To standardize the distribution, each of the distances between associates was binned in .25 mile containers and then the mid-point of each container is used to represent the data point of that bin. For instance, a distance of 1.09 miles would be binned to 1.00-1.25 miles and then the data point used would be 1.13 (the midpoint between 1.00 and 1.25 miles). Figure 6.2 shows the standardized distribution of distance travelled to criminal associates involved in drug production.

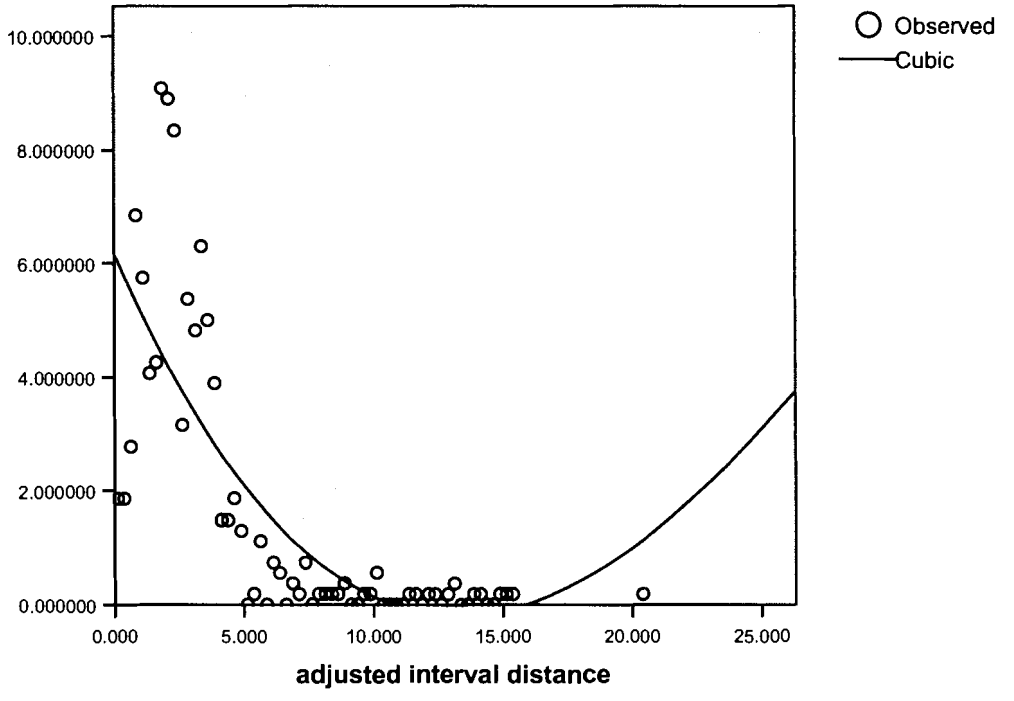
Figure 6.2: Standardized Distribution of Distance Travelled to Criminal Associates Involved in Drug Production



After fitting several curve estimation regression equations to the distance distribution, the cubic form was found to have the best fit (R^2= 0.590, F=28.329, p<.001). Figure 6.3 shows the observed distribution and the cubic regression line. A cubic model does not correspond to standard distance decay or journey-to-crime literature, which usually suggests a negative exponential or lognormal regression equation. The problem with using MLE regression equations in this case is that the current data are not independent, so standard curve estimations

are not the best method for modelling. The impact of this dependence can be seen in the peaks and valleys of the distribution. These peaks and valleys are representative of egos (with a geographic anchor) being connected to more than one alter (and their corresponding geographic anchor). The relatively low number of distance observations could also account for the cubic model fit.

Figure 6.3: Observed Distance Distribution and Cubic Regression Line of Best Fit



A relatively new method of simulation modelling called exponential random graph modelling (ERGM) is designed to build predictive models with non-independent observations (Hunter, Goodreau, & Handcock, 2005; Hunter &

Handcock, 2004; Snijders, Pattison, Robins, & Handcock, 2004). While this technique will not be used in this dissertation, future research on this data will include ERGM including social network and spatial variables. The next section of this chapter focuses on identifying some of the variables that would be included in future ERGM on predicting the geographic space of criminal networks.

6.6.2.2 Social Network and Distance Correlates of Organized Crime in Marijuana Grow Operations

To assess the relative importance of the centrality variables, a regression using randomization tests was performed. A correlation matrix revealed no problems of multicollinearity in the data. The highest correlation was 0.657 (degree centrality with eigenvector centrality), which is below the standard 0.700 benchmark set by Tabachnik and Fidell (1989).

Table 6.2: Distance Correlation Matrix*

	avg.distance	betweenness	degree	eigenvector	closeness
avg.distance	1.000	0.302	0.451	0.323	0.336
betweenness	0.302	1.000	0.625	0.579	0.122
degree	0.451	0.625	1.000	0.657	0.115
eigenvector	0.323	0.579	0.657	1.000	0.228
closeness	0.336	0.122	0.115	0.228	1.000

Table 6.3: Multiple Regression of Distance Between Associates and Network Centrality Measures*

Independent Variable	Close distance	Average distance	Far distance
betweenness	-0.056	0.347	0.114
degree	-0.443	-0.208	0.191
eigenvector	0.043	0.002	-0.060
closeness	0.256	0.251	0.115
R^2	0.118	0.150	0.097
F value	3.015	3.980	2.427

*all probabilities based on randomization tests, so no significance is provided.

Table 6.3 shows that the most predictive model is obtained using average distance as the dependent variable, and the model constructed for far distance is the least predictive. While the model for average distance only accounts for 15% of the variance, this, in addition to the absence of theoretical evidence to the contrary, is enough to suggest that average distance is the most appropriate distance measure for associates. The centrality measure that explains the most variance in average distance travelled to associates is betweenness. Associates who have a high betweenness centrality travel further to their associates. Closeness centrality also has a positive regression coefficient indicating that individuals who have a high graph theoretical distance, or are closer in the social network, travel further to their associates. Degree centrality has a moderate negative regression coefficient, indicating that associates with a high degree centrality travel a shorter distance to their associates.

6.7 Discussion

The results in this chapter must be qualified with the statement that the network is incomplete and contains fuzzy boundaries. Individuals who have criminal histories are more likely to be included in the network (node inclusion) and have more ties known to the police (edge inclusion) than individuals who have managed to avoid being charged with a crime. While the incomplete network is a serious consideration for the generalizability of results, it is an unavoidable issue in the study of hidden criminal networks.

The results of this research add a new dimension to the journey to crime literature – journey to criminal associates. The distance between associates in a criminal network is on average 3.96 miles. The average closest distance between associates is 1.49 miles, and the average farthest distance is 8.06 miles. There is also a clear directionality of the associate's home locations. This suggests that the criminal network involved in drug production is spatially constrained.

In connecting the current research to the Brantingham's (Brantingham & Brantingham, 1984c) concept of the buffer zone and distance decay model of offending, it appears that there is a .5 mile buffer zone around the homes of the individuals where associates are less likely to live. The distance to associates peaks around 2.5 miles and then loosely follows a distance decay model. These findings suggest that individuals involved in a criminal network do not live in extremely close proximity to one another, but they do tend to live in the same neighbourhood. This suggests that in building criminal associations,

environmental psychology concepts such as the least effort principle (when multiple destinations of equal desirability are available, all else being equal, the closest one will be chosen) are instrumental. This research also shows that drug production locations tied to the criminal network may be anchors that keep people, and thus the criminal network, tied to a particular spatial area. This follows the central tenets of Routine Activities theory.

The results further suggest that the distance between individuals in the drug production criminal network and their associates vary systematically with network characteristics (centrality measures) but not with demographics or criminal history variables. Of particular importance to police investigation into criminal organizations is the finding that central figures in the network, individuals high in betweenness, degree and closeness centrality, travel further to associates and place themselves on the geographic periphery of the *network habitat*. There are two possible reasons for this. First, central figures in a criminal network are more likely to profit economically and have more to lose if the police discover criminal activities of the network (i.e. a grow operation location). It follows that these central figures will distance themselves geographically in order protect themselves from police detection. However, the central figures still need to be close enough to the network habitat in order to manage routine logistic concerns, not unlike legitimate business managers. Second, central figures who have more economic means would rather live in an affluent neighbourhood, all things being equal. The less central figures in a network who deal with the day-to-day running of a drug production facility, can

not usually afford to live in affluent areas. Therefore, the core of the network tends to be concentrated in a low to mid income range area, and the central figures in the network extend the periphery of the *network habitat* to more affluent regions.

The type of results presented in this chapter can inform intelligence-led policing policies in a number of ways. First, identifying individuals central to a criminal organization, often termed "key players", will help police managers target surveillance efforts. Rarely are police fiscally able to surveil an entire network, so it becomes essential to target individuals who are central to the network. Second, isolating a criminal *network habitat and niches*, or the geographic setting the network lives and offends in, allows police managers to target surveillance and community-based crime prevention/reduction initiatives geographically.

7 CONCLUSION

The previous chapters have provided evidence and direction for policy makers dealing with the issue of marijuana production in British Columbia (BC). A descriptive analysis of the "grow op" industry was discussed before moving into a spatial analysis of the effects of police tactical teams (green teams) on grow operations. The final chapter focussed on the involvement of organized crime in the marijuana production industry and employed a social network analysis (SNA) framework to illustrate the involvement of different clusters of criminal associations. Using the case of Vietnamese drug production as an example, SNA and geographic information systems (GIS) analyses techniques were combined to asses the spatial and social linkage patterns in statistical and visual terms.

The descriptive analysis of police records shows that marijuana "grow ops" increased dramatically from 1997 through 2000, before levelling out by the end of the collection period in 2003. A significant increase in the number of suspects of Vietnamese origin was also noted. The police hypothesize that Vietnamese organized crime has effectively taken over the production of marijuana in certain jurisdictions and that they work with other criminal organizations (i.e. Hells Angels and Southeast Asian Groups) to distribute the drugs.

Chapter 5 results suggest that those areas with specialized anti-grow (or "green") teams show a significant decrease in grow operations within their jurisdiction. Compared to the rate of increase in the period preceding green team implementation, the treatment jurisdictions experienced an 82 percent decline in marijuana cultivation. This decrease begins within the first year of their introduction. Neighboring control areas experienced a seven percent increase in grow operations post-treatment.

Though the results presented in this chapter suggest that green teams are reducing the number of grow operations in a jurisdiction, one can not say whether effective grow team investigation is leading to displacement into neighboring jurisdictions with any certainty. Albeit marijuana grow operations continued to increase among the neighbors, the rate of increase at least slowed compared to the pre-treatment rate (33% decline in growth rate pre- to post-treatment). Similarly, without access to more micro-level data on the decision making processes of grow operators, there is no way of knowing whether the slowing of growth represents a positive externality by way of the diffusion of the benefit of grow team adoption in adjoining areas. Clearly, however, the payoff of adopting a targeted intervention in the face of unchecked growth of grow operations far outweighs the benefits of doing nothing.

The network analysis of drug production networks in chapter 6 illustrates that the criminal networks involved in drug production is spatially constrained. It also shows that the distance between individuals in the drug production criminal network and their associates vary systematically with network characteristics

(centrality measures) but not with demographics or criminal history variables. Of particular importance to police investigation into criminal organizations is the finding that central figures in the network, individuals high in betweenness, degree and closeness centrality, travel further to associates and place themselves on the geographic periphery of the *network habitat*.

It also appears that there is a .5 mile buffer zone around the homes of the individuals where associates are less likely to live. The distance to associates peaks around 2.5 miles and then loosely follows a distance decay model. These findings indicate that individuals involved in a criminal network do not live in extremely close proximity to one another, but they do tend to live in the same neighbourhood. This suggests that in building criminal associations, environmental psychology concepts such as the least effort principle (when multiple destinations of equal desirability are available, all else being equal, the closest one will be chosen) are instrumental. The research also shows that drug production locations tied to the criminal network may be anchors that keep people, and thus the criminal network, tied to a particular spatial area.

7.1 Future Directions in Policing Policy to Reduce Marijuana Growing Operations in BC

After reading this dissertation, the natural question is: how does this research inform evidence-based police policy and planning? The following sections address this question, focussing on each results chapter.

7.1.1 Descriptive Analysis of Grow Operations

This chapter confirms that British Columbia has a serious problem with marijuana growing operations. Simply by providing descriptive details of the problem, police managers can target specific areas, dwellings and offenders in hopes of focusing enforcement efforts. Area specific policies might include targeted marijuana enforcement teams, community awareness efforts, or situational crime prevention such as those discussed in the introduction. Offender targeted policies are also discussed in the introduction.

Over the period studied, the evidence indicates that marijuana grow operations have become larger and involve more technological enhancements. This increase in the size of operations has led to an associated increase in the average amount of electricity theft per incident. This increase in theft has motivated the electricity/power utility in the province, BC Hydro, to increase their cooperation with the police and not only target houses where electricity theft is suspected, but also where over consumption of electricity is observed. An evaluation of the effects of coordinated policies between BC Hydro and the police is an area for future research. One such avenue for policy consideration is to effect a truly cooperative approach to crime reduction through government agencies, public corporations/authorities (such as power, health and transportation) and law enforcement officials. Information sharing seems to be particularly problematic and anecdotal discussions with persons from these fields suggest that there may be some confusion as to the role of freedom of information, privacy and investigations involving threats to public safety. At a

minimum, a clear statement from the Ministry of Public Safety and Solicitor General would help provide some momentum in this direction.

One particularly contentious issue coming from the descriptive research is the significant increase in the number of suspects of Vietnamese origin. Any policies targeting Vietnamese individuals should consciously avoid racial profiling of suspects. Policies targeting Vietnamese organized crime and gangs in certain areas would be a productive outcome of this research. This will be discussed in the section on policies arising from the network analysis of organized crime involved in grow operations.

The analysis of the criminal justice system's response to marijuana cultivation offences in BC illustrated that cases are complex, varying widely in size, value, and whether or not other related criminal activities are involved. Approximately half of the cases were dealt with informally as no case seizures. There was a positive correlation between the size of the grow operation, the severity of the penalty handed down in court, and, at the Crown decision-making stage of the process, there were significant numbers of stays of proceedings and plea bargains, both of which resulted in a considerable attrition of charges and suspects. In the final analysis, the results of this study are disconcerting. As of 2003, the number of marijuana grow operations is still high and the overall estimated production associated to those incidents is four times higher in 2003 than in 1997. Despite this reality, and despite the fact that it has become increasingly apparent that grow operations pose a risk to public safety, the criminal justice system has been unable to respond. Specifically, police agencies

overall are less likely to fully investigate incidents coming to their attention and less likely to move cases forward by recommending charges to Crown Counsel; prosecutors are less likely to accept charges recommended by police and less likely to move forward with charges; and judges are less likely to send an offender to prison for their participation in a grow operation, despite offenders becoming more prolific and more violent. Both the police and courts should heed these results as evidence that the criminal justice system is not capable of handling the amount of marijuana grow operations in the province.

Finally, since the research showed that approximately 15% of indoor grow operations contained at least one hazard (i.e. weapons, booby traps, explosives, chemical products, other drugs, and fire), police managers should have no trouble marketing marijuana grow operation reduction efforts to the public and to city counsels responsible for budget allotments. The Premier of British Columbia recently provided funding to law enforcement agencies to increase their capacity to respond to the risks posed by grow operations. Additionally, the R.C.M.P.'s Coordinated Marijuana Enforcement Team was recently formed to direct a more strategic, intelligence driven approach to the problem.

7.1.2 Spatial Analysis of Green Teams

Chapter five shows that the payoff of adopting a targeted intervention in the face of unchecked growth of grow operations far outweighs the benefits of doing nothing—quite literally the response for some agencies during the study period—or providing only minimal investigative efforts to establish if a reported grow was in fact "founded" or not before closing the file. Similarly, adopting

policies aimed at disrupting local grow operations reduced the operation levels in comparison to activity levels within jurisdictions that chose to reduce the level of enforcement/ prosecution. Police managers should pay close attention to the evidence presented in this chapter. It would not be prudent for a police jurisdiction close to other jurisdictions with green teams or drug squads to adopt a "no action" policy.

7.1.3 Network Analysis of Criminal Organizations

The type of results presented in this chapter can inform intelligence-led policing policies in a number of ways. First, identifying individuals central to a criminal organization, often termed "key players", will help police managers target surveillance efforts. Rarely are police fiscally able to surveil an entire network, so it becomes essential to target individuals who are central to the network. Second, isolating a criminal *network habitat and niches*, or the geographic setting the network lives and offends in, allows police managers to target surveillance and community-based crime prevention/reduction initiatives geographically.

Network analysis also represents a significant improvement over simple collections of repeat offenders, as these individuals may be high volume "street criminals" (and represent a significant time investment for courts and police agencies in their own right), but are unlikely to be the most dangerous or even the most socially damaging offenders. "Key player" and other social network techniques allow researchers and analysts to develop more intelligence-led policing strategies and support such efforts with empirical data in a way that only recently was not technologically possible except for small groups of known

offenders/suspects and involving truly time intensive, hand analysis, by police specialists. Finally, network analysis allows, in some cases, for sophisticated crime syndicates or associations to be studied by social scientists without compromising police investigations or disclosing suspect/offender identities, as the analyst does not require full access to police files, or at least not in the same way that analysing such associations by hand would typically involve.

7.1.4 Moving Beyond Police-Based Policies

This dissertation has focused primarily on police-based prohibition policies for controlling the growth of marijuana growing operations. This is reasonable considering the nature of the data and focus of the research. However, it would not be prudent to ignore policies based on libertarian/market approach or harm reduction. This section briefly recaps such policies, set up in the introduction, and then presents a nuanced consideration of policy choices incorporating prohibitionist, harm reduction and the libertarian/market approach.

After years of stagnancy, the drug policy debate, particularly in relation to marijuana possession, has garnered renewed interest from the Government of Canada. Most involved in the debate agree that current prohibitionist policies are not effective in reducing harm caused by illicit drugs. In fact, many assert that prohibition contributes to the harm caused by drugs. Specifically, cannabis prohibition has been a substantial financial drain on the criminal justice system for the past thirty years and has failed to reduce the production, distribution and consumption of marihuana (Dandurand & Chin, 2003). The Government of Canada has to consider many different factors when deciding which drug policy

to implement, including evidence on the effects of different drugs and different policy strategies, and international ramifications of liberalization.

Albrecht and van Kalmthout (1989) delineate four policy options to liberalize drug policy. The first option, based on a libertarian, free market approach involves legalization of all drugs, where possession and trafficking would no longer be criminalized and the sale and or production of these drugs would be taxable by the government. The second option entails categorizing drugs from least to most harmful, assigning a risk value, and decriminalizing the least harmful. Theoretically, these policies would reduce marijuana growing operations by reducing demand for the drug from illicit sources. The third policy model would see possession of small amount of all drugs decriminalized. The fourth option, based on harm reduction principles involves identifying excessive, highly addicted users and introducing a prescription-based access program (Albrecht & Van Kalmthout, 1989; Chatwin, 2003).

There would likely be significant ramifications if Canada were to liberalize its marijuana policy in the face of an entrenched prohibition stance in the United States. The United States would likely hold Canada responsible for much of the marihuana illicitly crossing the borders into the country, regardless of the actual source. The blame would possibly extend to harder drugs like heroin and cocaine even though these drugs remain criminalized in Canada. This is akin to the Netherlands being held responsible for supplying much of the illegal drugs in Europe despite the fact that most illegal drugs, including marihuana, enter Europe from "producer countries" like Pakistan, Columbia, South Africa, Nigeria

and Thailand (European Union, 1999). Seeing Canadian drug policies as threatening to the social and moral foundations of their countries, Mexico and the United States may unite in an effort to promote prohibitionist policies throughout North America. This is what happened in the European Union when the cities of Stockholm, Berlin, Dublin, London, Madrid and Paris formed the European Cities Against Drugs (ECAD) to promote zero-tolerance drug policy. "Blame" for supplying the US with drugs in this context would almost certainly result in economic sanctions, if not multilateral condemnation by US-dominated economic-political organizations. One need only refer to the banning of "Canadian" products (or even products that sounded Canadian, such as "Canada Dry" ginger ale, which is a British company) during US military involvement in Iraq to sense how fragile relations with our southern neighbour can be. Not only would trade be disrupted, but border security may become strengthened beyond the already high post-9/11 levels. Canada cannot afford to lose the United States as a friendly trade partner. In 2003, the United States imported over 223 million dollars worth of goods from Canada and is by far Canada's largest trade partner (U.S. Census Bureau, 2003).

Strengthening the likelihood that the above actions will occur is the fact that American "drug paranoia" has already begun. Canada is in the unusual position of being both a "consumer country" and a "producer country", as it has a lucrative marihuana cultivation industry dominated by organized crime. Canada has not yet decriminalized marihuana and is already having to answer for much of the drugs finding their way to the United States, despite the fact that the vast

majority of drugs in the United States are supplied domestically or by Mexico and South American countries.

So what should Canada do to deal with the problem of marijuana growing operations? The evidence in this dissertation does support the prohibitionist notion that intelligence-led policing and targeted police enforcement help to reduce the number of growing operations and understand the organized crime link to the illicit industry. However, as mentioned in Chapters Five and Six, police-based prohibition policies alone are unlikely to dramatically reduce the number of grow operations in the province. It is the author's contention that liberalization of marijuana possession laws along with intelligence-led policing policies controlling marijuana cultivation provide a more nuanced approach to the issue of marijuana grow operations.

Like many problems of crime causation or criminal justice policy, simple solutions offering only one type of redress, policy or crime reduction tactic is unlikely to succeed. This dissertation concludes with a call for more integrated efforts to make more effective use of the already significant criminal justice budgets. Organizations like the Vancouver Agreement Coordination Unit, which work in lose working groups to plan for and implement strategies under the City's "Four Pillars" approach are promising starting points, but require embedding in long-term planning before the fruits of their labours is likely to be noticed. As is argued in the crime prevention and crime reduction work of Felson and the Brantinghams, that such policies require "embedding" within other policies before funding disappears for specific, 'high profile" crime prevention policies have run

their course. Crime reduction is a long term commitment, and cannot survive the typical politically bounded half-life. Policies such as the Four Pillars and other more holistic strategies have at least the advantage of serving multiple purposes, and as such, are less likely to ignore the needs of any one policy focus or agenda for long, be it prevention, prohibition or harm reduction. Finally, coordinated programs and policies by necessity demand a wider range of practitioners, researchers, planners, and with them, one can be hopeful for more innovative solutions than one might find when only one interest group is at the helm.

APPENDIX: DATA SOURCES

Four data sources were used in this dissertation:

1. **Marijuana Grow Operation Case Files**

To collect a complete dataset on incidents of marijuana cultivation coming to the attention of police in British Columbia, every law enforcement jurisdiction in the province was visited and all of the concluded marijuana production files for the time period 1997 through 2003 were reviewed. In addition to reviewing each file, each suspect mentioned in the file had their criminal histories retrieved from the Canadian Police Information Centre (CPIC) database, based on each suspect's FPS (fingerprint) identification number. The site visits were secured by R.C.M.P. "E" Division officials for both R.C.M.P. detachments and all municipal police departments.

The coding instruments used in data collection are located in the Plecas et al. (2005) study. There is one coding form for incident data, one to collect information on each suspect, and a criminal history coding sheet to collect information retrieved from the CPIC run on each suspect. Specific variables collected include: the location of the growing operation, the nature and origin of the complaint, the police investigation, the size and type of the growing operation, the amount of marijuana seized, the presence of other drugs, the presence of various cultivation equipment, decisions made by the prosecution, and the sentencing outcome (Plecas et al., 2005). After data collection, each

incident form, suspect form, and criminal history form was entered into the Statistical Package for the Social Sciences (SPSS). The incidents were connected to corresponding suspects and criminal histories using unique identifiers on each form. After the data entry was completed and verified, all identifiers were removed from the database.

2. Surrey Fire Service Data

To examine the risk of fire associated to marijuana grow operations, the City of Surrey through its fire department (Surrey Fire Service) provided the Centre for Criminal Justice Research (CCJR) at the University College of the Fraser Valley with historical data on all fires in Surrey. Surrey Fire Service also provided their official incident reports for each attended fire associated to a marijuana grow operation over the entire seven-year time frame of the Plecas et al. (2005) grow operation study. Specifically, information on all such fires occurring from January 1, 1997 through December 31, 2003 were collected. Along with this information, data was provided on the number of single family residences in the City of Surrey for each of the seven years from 1997 to 2000 inclusive.

The official fire data, the information on the number of single family residences, and the official incident reports were important because they enable researchers to consider the incidence of fires at grow operations relative to the incident of fires in general in Surrey. Equally important, both the official fire data and the individual fire reports allows cross-referencing of the previously mentioned police-based database (see #1 above) on grow operations to confirm

that the analysis would only include those cases which made explicit reference to fires originating from an electrical problem associated to the presence of a grow operation within a single- family dwelling. Accordingly, all individual reports of grow operation fires occurring in anything other than a single-family dwelling (ie. we excluded sheds, barns, commercial buildings, apartments, multiple family dwellings) were excluded. Any incident reports of grow operation fires if the suspected cause of the fire was not clearly and specifically described as being tied to an electrical issue were also excluded.

3. Associate data

Data on 376 individuals involved in an illicit drug production organized crime network in Vancouver, British Columbia were collected. The data were collected from the case files generated by the Vancouver Drug Unit, which identified both suspects and their associates who were known to operate multiple marijuana grow operations in the jurisdiction between 1997 and 2003. The primary members of the criminal network were identified by membership in a criminal organization, recognized through a common group name, sign, identifying characteristic, and an involvement in illicit drug production, particularly marijuana growing operations. In addition to capturing primary members of the drug production network, their associates were identified. In order to be classified a criminal associate of a primary member, the individuals must have co-offended together, be relatives, or be deemed criminally connected through source-based intelligence (wires, surveillance), or some combination of the categories. It is important to mention that not all co-offenders or family members are included in

this data, only those also involved in the illicit drug trade. In this regard, our primary members were selected using the "positional" sampling approach and their associates were chosen using "reputational" sampling approaches, as described by Scott (2000).

4. Police Jurisdiction "Green Team" Policy Data

Data pertaining to the type of policy adopted in response to marijuana grow operations in each jurisdiction was collected as an extension to the Plecas et al. (2005) study. Each police jurisdiction in British Columbia was telephoned and asked whether there was a "green team" and/or a drug squad implemented in the jurisdiction, the date of implementation, and for the few cases where the effort was abandoned, the end date.

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