

USING GIS AND DIGITAL AERIAL PHOTOGRAPHY TO ASSIST IN THE CONVICTION OF A SERIAL KILLER

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ABSTRACT

A desktop geographical information system (GIS) was used to pin-map the 86 cases associated with the Wemmerpan serial killer, representing crimes committed between 17 September 1995 and 19 December 1997 in central, western and southern Johannesburg, South Africa. The crimes ranged from murder and rape to assault with intent to cause grievous bodily harm. A series of maps were produced, using either digital street-map data or ortho-corrected digital aerial photographs as the backdrop.

The photographs were particularly useful for incidents that occurred around Wemmerpan itself, a popular recreational area consisting of a dam (Wemmerpan) surrounded by picnic areas, a small forest, open ground, mine dumps, footpaths and other geographical features not normally found on a street map. The maps were used in court to show the geographical extend of the serial killer's activity space and to help the court understand the sequence of events as evidence was led. Historically, photographs of a wall map bedecked with stickers have been used in such cases, but they have proved to be unsatisfactory. The digital maps are much more flexible, versatile and easier to use.

DETAILED DESCRIPTION

Introduction

The Brixton Murder and Robbery Unit of the South African Police Service (SAPS) is responsible for the investigation of serial killers in the Johannesburg Police Area. On a visit to the unit to understand how they function and how crime mapping could assist them, researchers from the CSIR witnessed the traditional method of preparing maps for use in court cases involving serial killers: a police photographer took photographs of a wall-map, on which stickers had been placed indicating the locations of the crime scenes associated with the Wemmerpan serial killer. It immediately became clear to us that such photographs would be difficult to use in court, which was confirmed by the police officers present, and we offered to try to produce better maps using a geographical information system (GIS). The GIS would provide one with much greater flexibility, as once the data have been captured and verified, it is straight forward to produce customised maps, selecting the data to be shown, for example, time of day, day of the week, weapon used, crime committed, etc.

Crime data used to create the map

On the GIS we then pin-mapped the 86 cases associated with the Wemmerpan serial killer, representing crimes committed between 17 September 1995 and 19 December 1997. The crimes ranged from murder and rape to assault with intent to cause grievous bodily harm. We also went through the dockets to record several variables for each case, specifically:

- Map Number - this was the original number assigned to the scenes by the investigating officer on a normal paper map before the scenes were plotted on to a GIS;
- File Number - for each map number one or more file numbers were allocated. Each file contained the docket for a specific case. In some instances, such as when a couple was murdered at the same scene, two file numbers were allocated to one map number;
- Case Number - the unique case number allocated by the police station in

- whose jurisdiction the crime occurred, to register the reported criminal act(s) on the Crime Administration System (CAS);
- Date - the actual date or, where not known, the estimated date when the incident occurred;
 - Time - the actual time or, where not known, the estimated time when the incident occurred;
 - Sex - the sex of the victim (male or female);
 - Crime Type - the crime committed, eg: murder, rape and murder, or assault;
 - Address - the location where the incident occurred;
 - Instrument - the type of instrument used when the criminal act was committed, such as a hammer or a pistol;
 - *Modus operandi* - the method used to commit the crime, eg: hammer blows to the back of the head of the victim, when the victim was alone in his shop;
 - Raped - if the victim was a female, was she raped or not during the incident; and
 - Evidence - pieces of evidence found at the crime scene (the data base allowed for up to five to be recorded for each case).

These variables can be used to determine what should be shown on the map, and how, by using combinations of colours, symbols, font sizes and annotation. The aim is to provide the judge, prosecution and defence with clear, easy-to-use maps that give them a good overview of the crimes that were committed, so that they can clearly follow the proceedings of the trial. Additional maps allow the court to focus on a subset of all the cases, such as those committed in a specific area, or with a specific weapon, or on a specific day of the week. A symbol on the map can be used to represent the instrument used to commit the crime (such as a pistol or a hammer) and the colour of the symbol can be used to indicate the day of the week, etc.

Data used

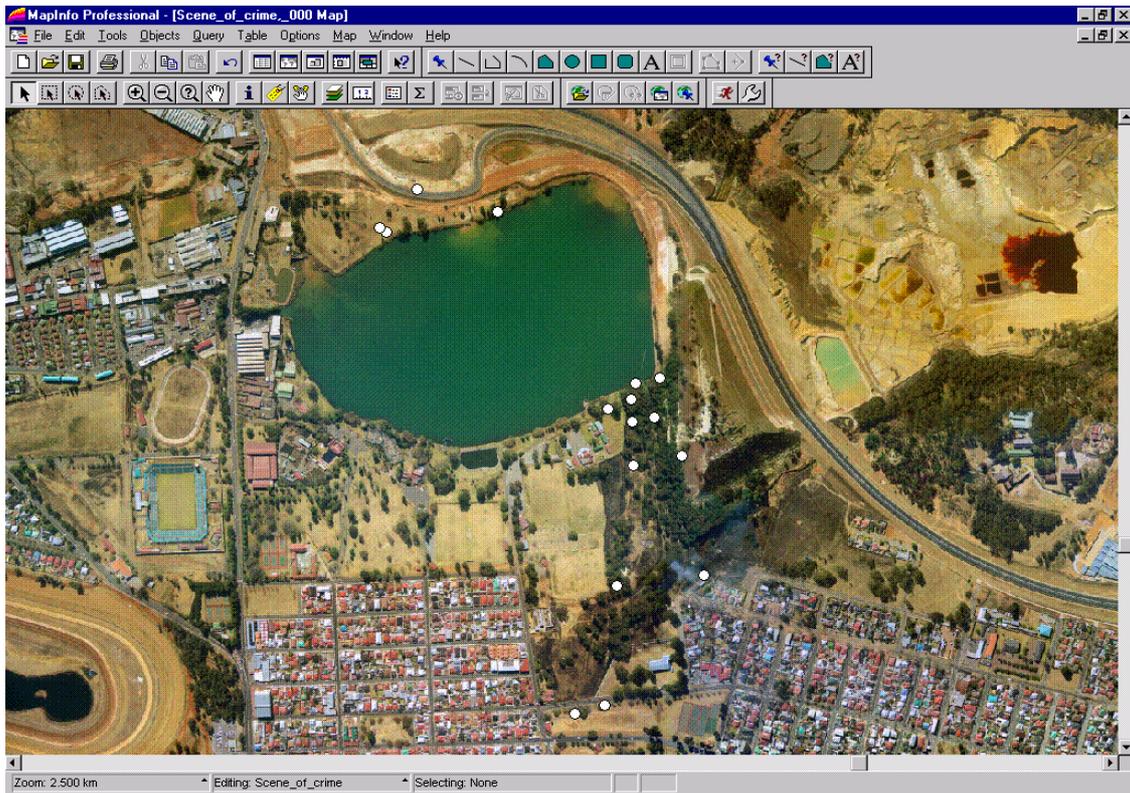
The following data were used:

- Digital street map for Johannesburg from MapStudio;
- Locations of incidents linked to the serial killer from SAPS;
- Attribute data of each incident from SAPS; and
- Digital aerial photographs from Cities Revealed, supplied by GIMS.

Mapping the locations of the crime scenes

A series of maps were produced, using either MapStudio's digital street-map data (familiar to many people through their street guides) or the Cities Revealed ortho-corrected digital aerial photographs as the backdrop. This data set consists of high-resolution colour aerial photographs, which provide an easy to understand backdrop for the crime-scene data. It provides greater detail than the

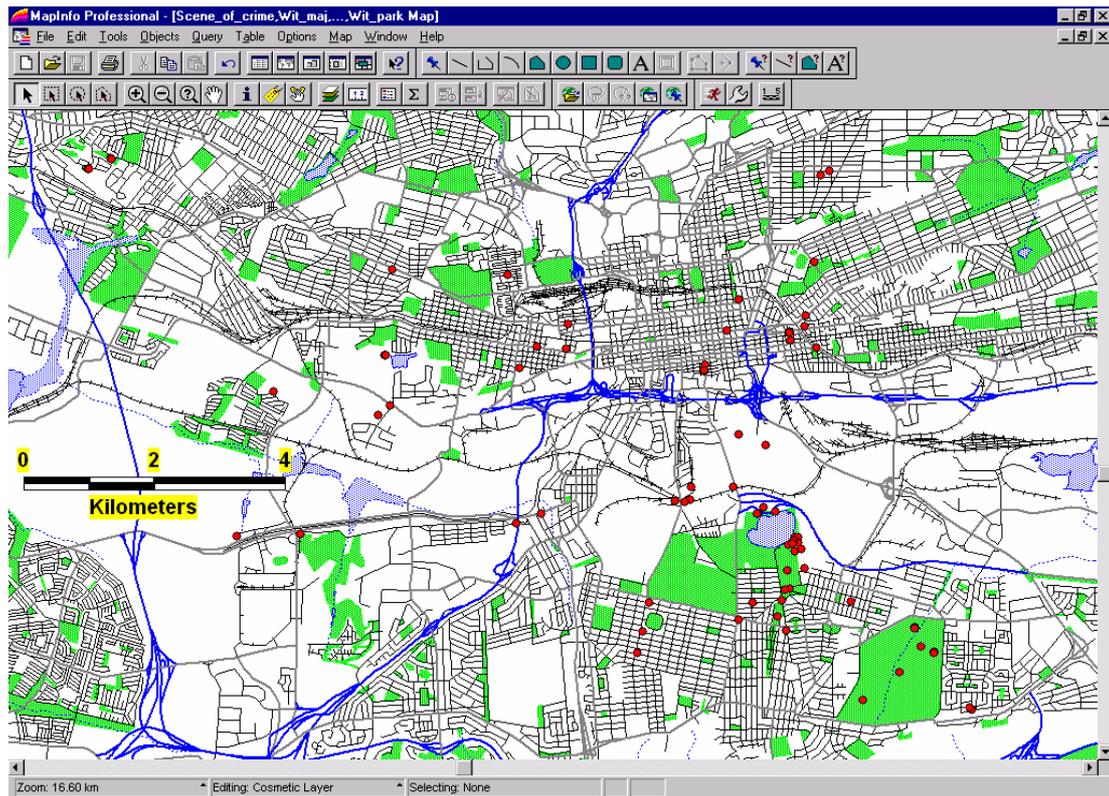
map data, especially in open areas such as those around Wemmerpan itself, a popular recreational area consisting of a dam (Wemmerpan) surrounded by picnic areas, a small forest, open ground, mine dumps, footpaths and other geographical features not normally found on a street map (see Map 1).



Map 1. Crime scenes with digital aerial photograph as backdrop

Using the digital street maps the different scenes based on the above information were mapped using MapInfo Version 4.5. This was done on a laptop at the office of the investigating officer. This was done for security reasons. The investigating officer assisted during the mapping phase, drawing on his knowledge of the area where these incidents took place.

The maps were used in court to show the geographical extend of the serial killer's activity space and to help the court understand the sequence of events as evidence was led. We believe that we have enabled the investigating officers and prosecutors to gain a better understanding of the case, and we believe that the maps have facilitated the court proceedings by providing all parties with clear pictures of where the crimes occurred. The purpose of this pilot project was to present the evidence, rather than solve the case (see Map 2).



Map 2. The geographical extend of the serial killer's activity space

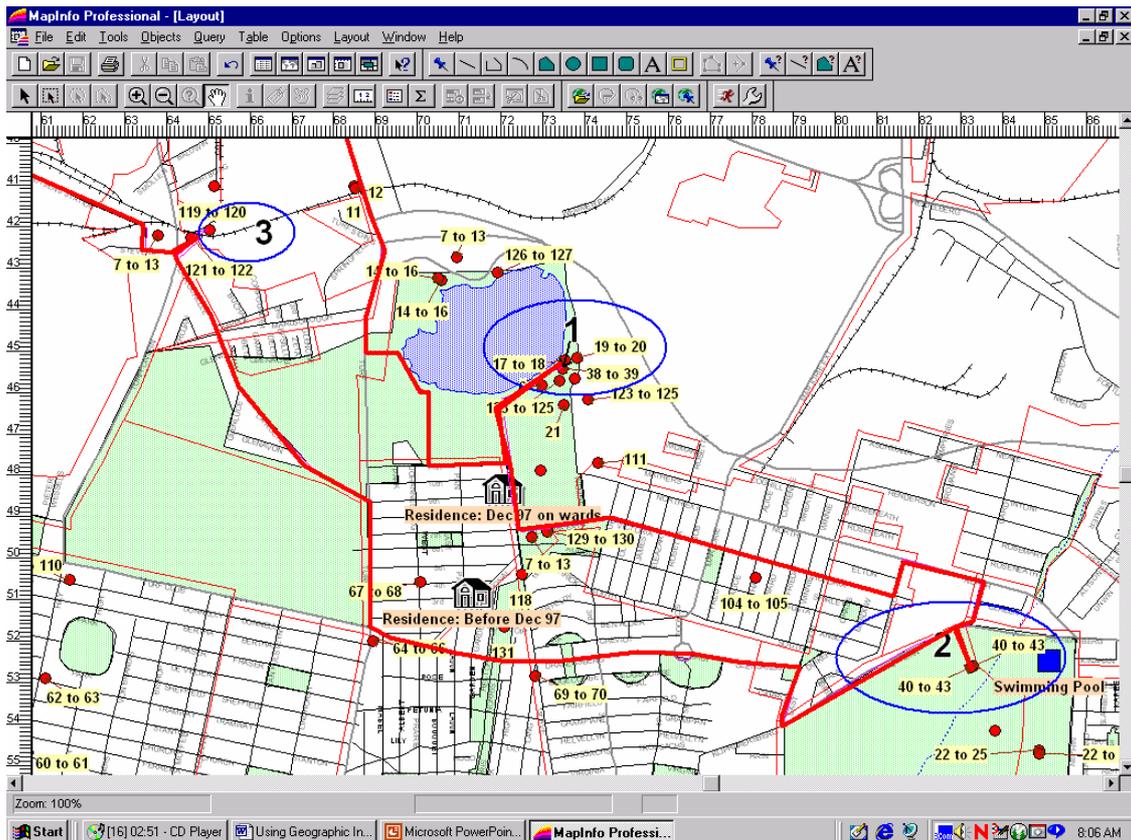
Mapping the routes taken and places indicated by the accused

The suspect was arrested late in December 1997 and initially, acknowledged responsibility for the crimes. On four separate occasions, he took independent police officers (with no prior knowledge of the case, to avoid prejudice) around the area to point out some of the crime scenes. Each route taken and the crime scenes pointed out (in sequential order) were also mapped on the GIS. For each

route, a separate map was produced showing the route and crime scenes, and indicating which police officer had accompanied the suspect on these trips (see Map 3). To map these routes, the routes were retraced by driving around with the investigating officer and the prosecution, taking notes on street names, street corners and the address if available.

Information overload

When the first map was presented to the prosecutors, it became clear that the map had an information overload. Although it was important to show the different types of weapons used and on which day the crime occurred, the prosecution



Map 3. The routes taken when the crime scenes were indicated

found it difficult to use the map effectively. It was then decided to simplify the map contents showing only the following on each map:

- The location of the crime scene; and
- The count numbers (the court number assigned to each case).

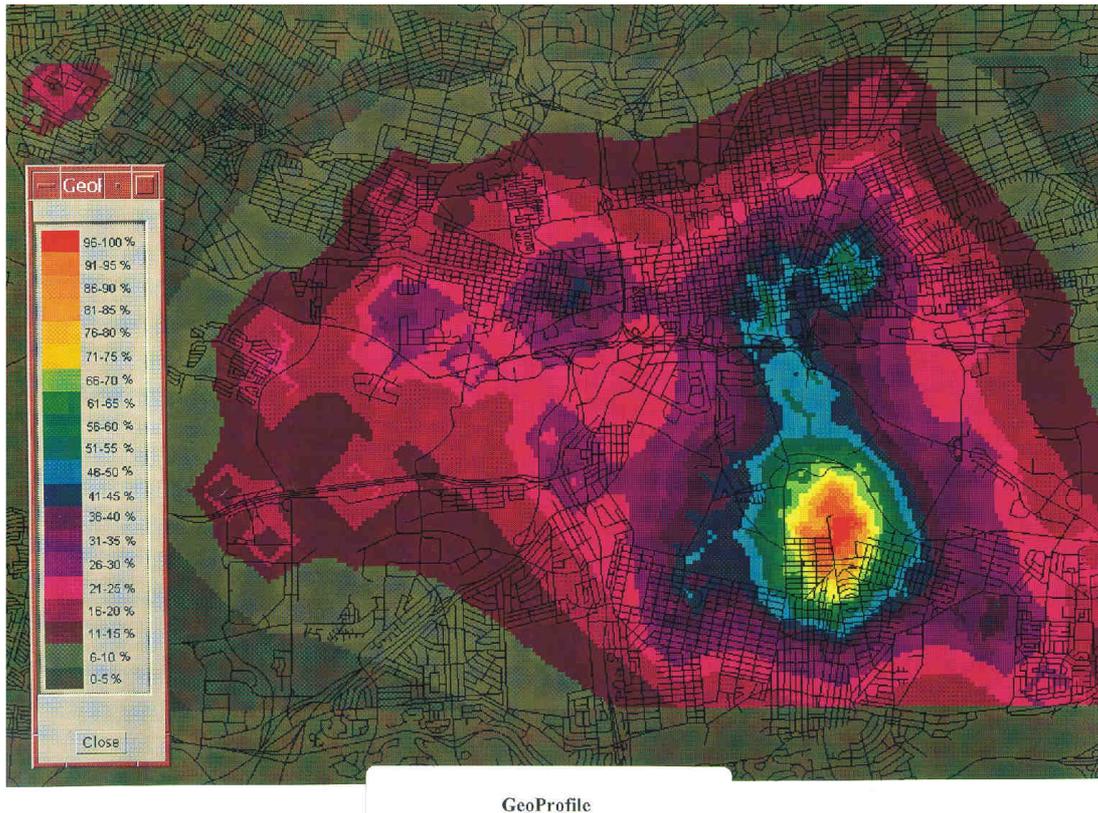
For the maps showing the routes taken by the independent investigating officers when the accused indicated the crime scenes:

- The route taken; and
- The number of scene indicated.

All of these maps were verified by both the investigating officer and the prosecution, before printing the final maps for court purposes.

Geographic Profiling

Geographic profiling is a technique that is applied to assist investigators in locating the residence of a serial offender, given the sites at which the offender conducted his crimes and / or disposed of his victims.



Map 4. The geographic profile of the Wemmerpan Serial Killer

Studies of offender behaviour have shown that serial offenders “hunt” in areas that are familiar to them, or in their so-called activity space. Geographic profiling is based on the inverse of this information, i.e. given that one knows where the sites of crime are, one can deduce where the offender most probably lives. The technique has mathematical models at its core, and a computer system has been developed by Dr Rossmo to assist investigators in applying geographic profiling in casework.

In collaboration with the Vancouver Police Department (where Dr Rossmo holds the rank of Detective Inspector), we also used the data to draw up a *post hoc* geographic profile of the case. In spite of the complexity of the case (one of the worst serial killers on record, three different *modus operandi* and short intervals between attacks), the analysis showed that most of the attacks were located around the suspects two places of residence, with the others being where he worked, where his girlfriend lived and where his brother lived (see Map 4).

The accused was convicted on most of the charges and received 27 life sentences. The CSIR has also assisted the Brixton Murder and Robbery Unit in a similar manner with the Nasrec serial killer case, which is still before the court.

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Effectiveness

The maps using digital street-map data and digital aerial photography provided the court with a clear picture of the geographical space in which the serial killer operated and to help the court understand the sequence of events as evidence was led. The maps were used constantly during the court proceedings. The accused was convicted on most of the charges and received 27 life sentences. The CSIR is currently assisting Capt Byleveld in a similar serial murder case.