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Identifying High Crime Areas Using Spatial Analysis

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Abstract

Crime incident locations and trends are examined spatially using GIS to produce maps that pinpoint high crime areas or "Hot Spots". Crime mapping aids police departments by identifying areas to allocate limited resources where and when they are most needed. This project introduces the availability of GIS technology to smaller police departments as a tool to assist in the development of crime prevention strategies. In this model crime incident reports for Windham, Maine are geocoded and patterns of motor vehicle and structure burglaries analyzed for date, time and location of incident. An addressing protocol is followed to protect victim privacy by masking the actual incident locations. The data is analyzed using the following four methods: point density; Getis-Ord Gi; Kriging and Anselin Local Morans I. Getis-Ord Gi* is the method usually associated with hot spot analysis, however, the results of this project favor the point density method which displays data in a raster format. The raster image has the greatest visual impact by clearly distinguishing degrees of high crime areas with a progressive coloring scheme ranging from blue to red. Seven "hot spot" neighborhoods were identified, prioritized from high to low and overlayed on E911 roads. The outcome this analysis resulted in 94 high priority and 54 medium priority roads being recommended for increased police patrol. This process can easily be replicated to measure the success of strategic policing plans.*

Introduction

A study published by the U.S. Department of Justice suggests a principal theme wherein crime hot spot maps can provide guided police action when the maps are guided by theory. The "Neighborhood Theory" discussed in the study is applicable to this project as the subject community's number one crime is home burglary. This theory links crime to underlying neighborhood social conditions. Some neighborhood characteristics may be made up of residents who work during the day and no one is in the area to report suspicious activity or it may be an economically depressed neighborhood of many multifamily homes that lacks a sense of community involvement, *"...depending on the neighborhood characteristics, relevant action might include efforts to engage residents in collective action against crime and disorder." J.E. Eck et. al. (2005).* Advances in computer and information systems now make it possible for smaller police departments to geographically identify clusters of high crime areas. The Town of Windham's burglary problem may be reduced by using GIS, spatial analysis and theory to influence decision making policies that implement targeted police patrols.

Methods

The Town of Windham, Maine has a population 17,001, covers 50 sq. miles, and has180 full and part-time municipal employees including a 29 member police department. The police department currently uses a hand drawn representation of the town's police zones made by Ronald Ramsdell (Windham Police Department, Retired) (Figure 1.). The Police Zones were originally established using road lines as zone separators and designed as a way to section off the town for call assignments but are not determined by frequency of crime, travel time or patrol patterns. The Police Zone Map was recreated in ArcMap with the Police Zones overlayed on the town Street Map for ease of reference (Figure 2.).

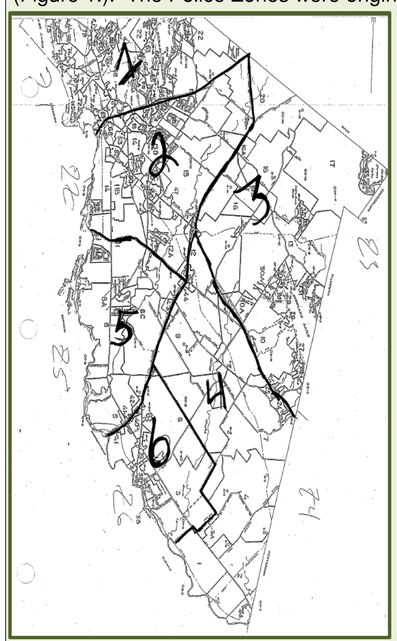

Figure 1. Original Windham, Maine Police Zone Map.

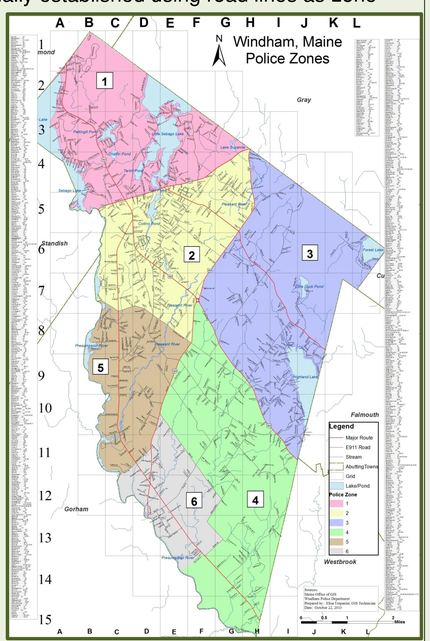

Figure 2. Updated Windham, Maine Police Zone Map with street index.

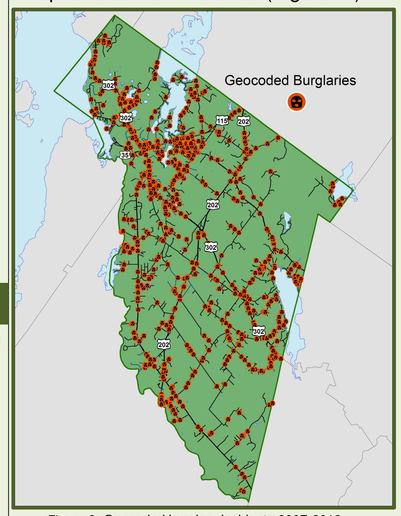

Figure 3. Geocoded burglary incidents 2007-2013.

Burglary incident data provided by Cumberland County Dispatch were geocoded (Figure 3.). Cumberland County dispatches for Windham and uses Spillman Computer Aided Dispatch (CAD) for records management. The Incident Report spreadsheet listed 1,052 burglaries from January 2007 through October 2013. Of these incidents 351 were motor vehicle burglaries and 701 were structure burglaries. Although point locations are shown on the map the actual addresses are suppressed from the data to ensure privacy. Considerable edits were required to sync the road name spelling protocol in each of the tables. During this process it was recognized that the primary data source may need to follow the E911 addressing protocol to expedite not only geocoding but also future reporting and analysis.

Several methods were explored to analyze crime distribution. Analytical tools used for this project include ArcGIS Desktop 10.1 with Spatial Analyst. Using the Point Density method and the geocoded burglary point locations a Hot Spot Map was produced as a raster data set to identify and highlight problem areas in red (Figure 4). The data results from this map were used to produce the project results shown in Figure 6. Other analysis methods used include: Getis-Ord Gi*; Kriging; and Anselin Local Morans I. These methods also produced a picture of the primary trouble spots, however, the point density method provides the most effective visual communication tool for municipal officials unfamiliar with the advantages of using GIS (Figure 4.). The northern most hot spots are located in a highly populated area of subdivisions and could fall into the "Neighborhood Theory". In addition to increased policing, these areas may benefit from community outreach programs like Crime Watch.

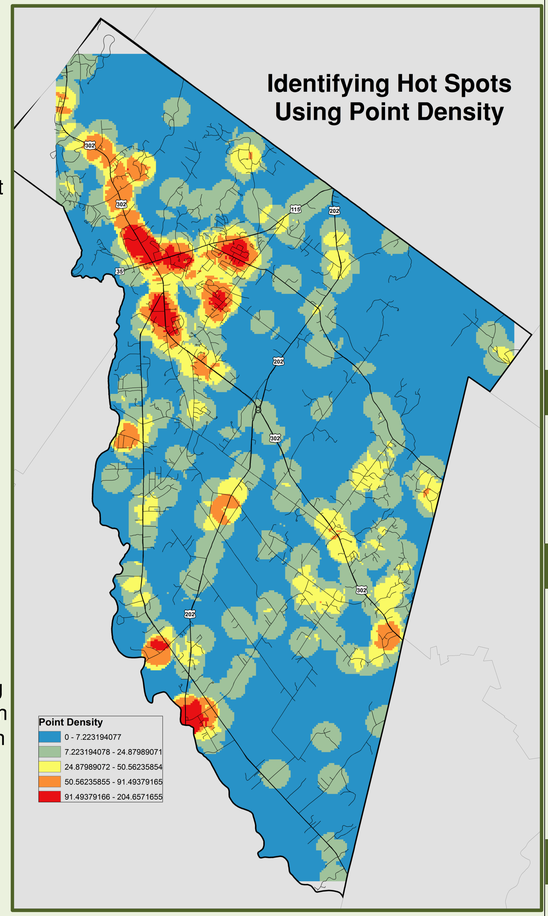

Figure 4. Identifying Hot Spots Using Spatial Analyst Point Density.

Results

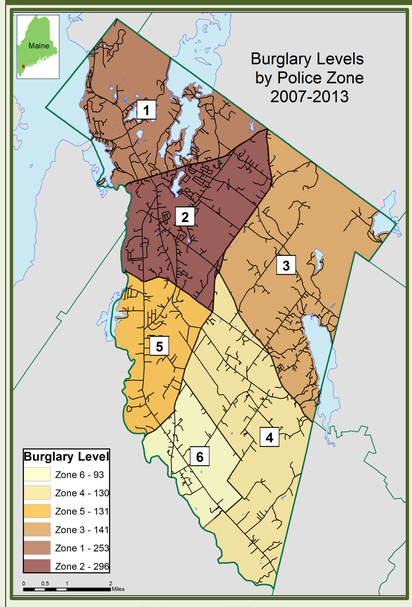

Figure 5. Burglaries 2007-2013.

Based on the Spatial Analyst Point Density Map previously shown in Figure 4, a point was centered within the hot spot areas of red and orange and categorized from high (red) to medium (orange). A 1,500' buffer was established around these points and *Select by Location* was used to identify roads within the high to medium crime range. 94 High priority and 54 medium priority road names were identified totaling approximately 40 miles of road. (Figure 6). This data identifies specific areas where targeted police patrols would reduce the patterns of repeated crime and victimization.

The choropleth map in Figure 5 shows the burglary counts by police zone for January 2007 through October 2013 with the highest number of burglaries occurring in Zones 1 and 2.

Burglary incidents peaked in 2009 and 2010 which seemed to coincide with the height of the economic recession in this area. Additional analysis indicated that autumn is the height of the burglary season and may be attributed to the reduced daylight hours.

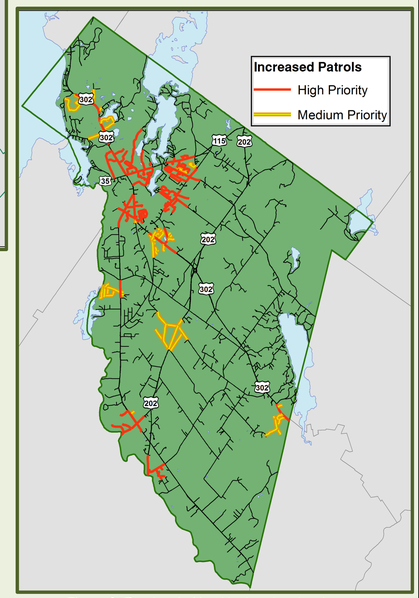

Figure 6. Roads prioritized by burglary level.

Future Development

Future development of this data will include a recommendation to the Windham Police Department to increase patrols in the areas categorized as high or medium; Periodic analysis of the results of implementation of the increased patrol areas; Repeat Address Mapping (RAM); analysis of assessing neighborhoods vs. crime activity and seasonal properties vs. crime activity; and analysis of crime in areas with and without street lights.

References

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http://en.wikipedia.org/wiki/Geocoding
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