Crime Analysis and Crime Mapping: Bicycle Thefts on the California State University, Long Beach Campus

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Introduction

Bike thefts are one of the most common crimes on the California State University, Long Beach (CSULB) campus. Crime analysis and crime mapping, most commonly used by law enforcement agencies, uses geographic information system (GIS) software to better understand and help solve tactical and strategical problems such as bike thefts. Overall, bike thefts make up 16% (1 out of every 6) of all crimes on the CSULB campus.

The purpose of this project was to use campus crime data and geospatial hotspot analyses to identify the areas on the campus that are prone to bike thefts. This project was the result of a collaboration with the CSULB University Police Department. Bike theft data were obtained from Crime Prevention Sergeant Keith Caires and the University Police (Table 1). The University Police do not use GIS, so this information had not previously been analyzed or spatially represented.

Data and Data Sources

Datasets	Source
Bike Thefts	California State University, Long Beach Police
Bike Racks	Personally collected
California State University, Long Beach Boundary	Personally digitized
2011 Aerial Imagery	LARIAC/California State University, Long Beach

Table 1. Data Sources

Methodology

Data Collection

- Collected bike thefts lists (Excel tables) from the CSULB University Police
- Field survey of all bike rack locations

Data Processing

- Digitize all bike thefts and bike racks

Data Analysis Methods

- Created fishnet polygons with different grid sizes and tested which one worked best
- Optimized Hotspot Analyses

Data Visualization

- Development of animated map

Year	Bike Thefts
2009 - 2010	109
2010 - 2011	47
2011 - 2012	67
2012 - 2013	54
2013 - 2014	76
2014 - 2015	48
Total:	**400**

Table 2. Amount of bike thefts per year

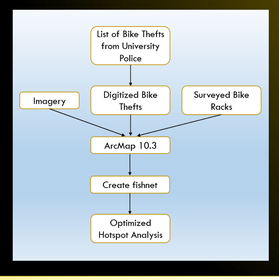
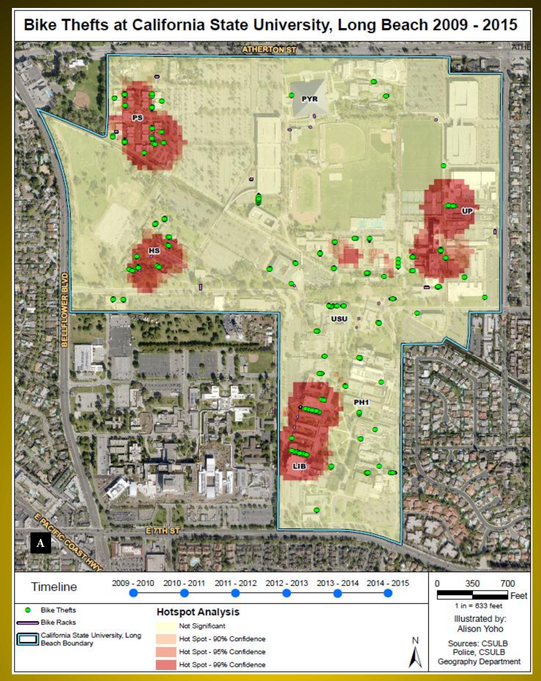
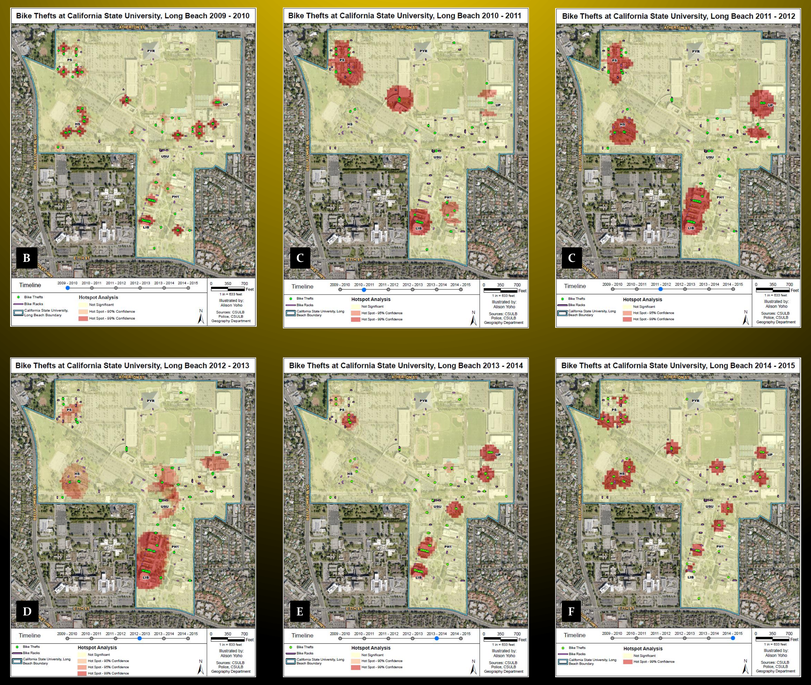


Figure 1. Data flow model

Results

The geospatial hotspot analyses resulted in a series of visualizations. Seven static hotspot maps were generated for each year in the study period which spanned from 2009 - 2015 (Figures 2). These individual maps were also incorporated into an animated map that was created with Windows Movie Maker. The bike theft datasets served as the source input data for an ArcGIS-based Optimized Hotspot Analysis. Each map displays the bike thefts, bike racks, the CSULB boundary, and the hotspot analysis for each year. The total amount of bike thefts over all of the years are displayed in Figure 2. The hotspot analysis produced maps of hotspots (red areas) which are areas on a map that indicate high crime intensity in those areas. Cold spots (blue areas) are areas on a map that indicate little to no crime in those areas.





Figures 2A – 2F. Bike Theft Hotspot Analysis Maps – 2A includes a combination of the years of bike thefts. 2B through 2F are the individual years of bike thefts. These maps show bike theft hotspots between the Fall 2009 and Spring 2015 academic years on the California State University, Long Beach campus.

Discussion

Results of this analysis can help the University Police understand, based on six years of data, where bike theft hotspots have occurred. This project demonstrates the effectiveness of spatial analyses in visualizing crime, and the ability to use spatially-enabled visualizations to potentially address bike crime on campus. These results could be used to effectively allocate police resources geographically across campus to address this issue. The results of this project could potentially be used to reduce the occurrence of future bike theft.

There were potential errors and limitations in my project. One limitation that I faced was having to digitize all of the bike theft points by hand. The bike theft data that I received from the University Police did not have a geographical location for any of the records. More than half the location data was too vague, requiring Sergeant Caires to review over 250 case reports to find more exact locations for approximately 150 of the 400 total bike thefts. There is also a human error in the system of the way each report is taken. Different officers take notes in different ways. When the officers take a bike theft report, some will take down more information than others. Additionally, data may have been eliminated from the analysis due to reports not taken.

Another limitation with this project was trying to figure out which tools to use. There are a few different hotspot analysis tools and several different ways to use each of them, each requiring different input parameters. After countless attempts at each hotspot analysis, I ended up creating a fishnet polygon feature class for the campus, and used the Optimized Hotspot Analysis tool. This tool, however, never provided me with cold spots in any of my analyses. I believe the test area may be tool small of an area and there were not enough bike theft records to be able to figure out where the cold spots were. From all of my analysis, I would say that the main areas where I think there should be a cold spot is near the Walter Pyramid, Music building, and Dance building.

Conclusion

The goals of this project were achieved. Hotspot analyses were performed for the bike thefts on the California State University, Long Beach campus representing 2009 - 2015. I created a hotspot analysis for each individual year, and all of the years combined, for comparison. The results of this project were provided to the police department for future planning purposes.

If I had the chance to improve this project, I would use ArcGIS Pro to perform the analysis. ArcGIS Pro has the ability to create space time cubes and has a time slider for animation. The space time cube can create a 3D version of the hotspot analysis so I would have been able to show all of the years at once. This could have helped to the 2D version of the space time cube. The 2D version could also be spilt up into each year as well.

For future studies, I would recommend comparing the bike theft crime to all other crimes on the campus. This could not only identify the overall crime hotspots or even other types of crime hotspots, but also where the safest places are on the CSULB campus. Additionally, the methodology could be applied to data from other campuses, to analyze similarities, differences and identify potential patterns to these crimes.

Acknowledgements

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