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Crime Mapping on National Forest Lands: A Case Study in the Shawnee National Forest

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CRIME MAPPING ON NATIONAL FOREST LANDS: A CASE STUDY IN THE SHAWNEE NATIONAL FOREST

by

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
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RESEARCH PAPER APPROVAL

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MAJOR PROFESSOR: Dr. Ruopu Li

Compared with urban crime studies, research on crimes and violence occurred in national forests is relatively scant albeit necessary. Understanding the spatial and temporal distribution of crimes and their explanatory factors is important to develop coping strategies and allocate resources to prevent the crimes. This study investigates the spatial and temporal patterns of the crimes in Shawnee National Forest during 2009-2014 based on data gathered through the Law Enforcement and Investigations Management Attainment Reporting System. It found that crime on the Shawnee National Forest is primarily centered on destination locations like trails or waterways, with more than half of all incidences committed within a ¼ mile of these sites. This study also found that there are major hot spots located on the western portion of the Shawnee, this area is near several major trails and parking area. This study is expected to help the Shawnee National Forest Law Enforcement identify the crimes types and their hotspots where resources on staffing, policing and training should be focused.

DEDICATION

For my amazing parents, Joe and Maureen Stauber, who have always supported my goals and pushed me to achieve my dreams. I appreciate all your help on this long and winding path, and for my boyfriend, Scott, who has been a constant source of encouragement and support, thank you for always pushing me to reach my potential.

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CHAPTER 1

INTRODUCTION

Hot spot mapping is the most widely used analysis for crime mapping. Hot spots are areas of higher density of crime in small geographic area. Mapping these areas give researchers information about wheat draws criminals to certain locations. This paper looks at crime mapping on the Shawnee National Forest (NF), which is situated in the Ozark and Shawnee Hills of Southern Illinois. At approximately 280,000 acres, it is the largest public land holding in Illinois. In 1939 then President Franklin D. Roosevelt designated the land that would be the Shawnee National Forest. Through the 1930s and 1940s, the Civilian Conservation Corps (CCC) reforested the land, built recreation sites, and road. Today, there are over 300,000 visits to the Shawnee National Forest per year; most visitors enjoy the forest for recreation, such as hiking, camping, swimming, hunting, fishing, and boating. There are others; however, that use the forest and its resources for criminal purposes. Each year hundreds of crimes are committed in Southern Illinois on National Forest lands. Crimes on National Forests are occurring at an alarming rate. Between urban sprawl and a national focus on getting outdoors, each year visitors inundate national forests. However, dwindling resources and funding has created major problems for the Law Enforcement Officers (LEOs) of the Shawnee National Forest (NF), and the Forest Service (USFS) as a whole. Each ticket or incident report includes as geographic location data, such as a GPS point, however lack of funding makes analyzing these point near impossible. By gathering and analyzing the data collected from the Shawnee National Forest (NF), local Law Enforcement officers will be able to locate crime hotspots, assess staffing needs and create management strategies.

1.1 Purpose Statement

What research into crimes occurred in the NFs is relatively limited compared with research in urban areas. The general research goal is to develop tools and strategies for coping with the crimes took place in the NFs. The specific objective of this research is to use geospatial techniques as a means to understand the spatiotemporal patterns of crimes that occurred in the Shawnee NF and develop coping strategies. This study is expected to help the Shawnee National Forest Law Enforcement identify the crimes types and their hotspots where resources on staffing, policing and training should be focused.

1.2 Research Questions

In this study, we will particularly research the following issues:

1. What types and amounts of the offenses occurred in the Shawnee NF?
2. What were the spatiotemporal patterns of these crimes reported in the Shawnee National Forests?
3. What management strategies should develop to help mitigate crimes in the forest area?

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Crime Mapping

Crime mapping and analysis are popular tools for the study of crime; this is because it helps identify problem areas. A key task of crime analysis is to predict where crimes are likely to occur because humans are habitual and many activities including crime incidents are not random. Crime incidents distribution may be dense at certain locations and sparse at others. The areas with a high density of offense rate are known as crime hot spots. There are several definitions of hot spots. For example, one definition of hot spots is "an area that has a statistically higher rate of crime than an average or random area in the same jurisdiction" (Ferguson 2011). Another definition is a small geographical area that experiences higher than average levels of crime for a consistent period (Hill and Paynich 2014a). While no common definition of hot spot exists, this research defines hot spot as a small geographic location that experiences high levels and frequency of crime for an extended period.

Activities in our daily life are highly affected by our perception of where those crime hot spots are. Eck et al. (2005) wrote, "crime is not spread evenly across maps. It clumps in some areas and is absent in others. People use this knowledge in their daily activities. They avoid some places and seek out others. Their choices of neighborhoods, schools, stores, streets and recreation are governed partially by the understanding that their chances of being a victim are greater in some of these places than in others". Police use this knowledge to allocate resources, such as more patrols in higher risk areas or better training. Hot spots analysis is widely regarded as central to crime analyses.

2.2 Urban Vs Rural Crime Mapping

Urban areas boast significant resources, better staffing, a higher crime rate, and more densely populated area that make crime mapping more realistic. Rural areas, in contrast, struggle to implement crime mapping/crime analysis because of the resources are less abundant, there is less training, inadequate funding, and lack of personnel (Carleton et al., 2014); Ceccato 2015). Nestled in rural environments most National Forests and surrounding communities see an influx of crimes, but little workforce to help slow the progression of offenses. A review of several case studies, in both urban and rural settings, allowed for comparison of the two types of areas, while primarily focusing on rural communities. The first urban study looked into whether vegetation encourages or suppresses urban crimes, specifically in Philadelphia, Pennsylvania (Wolfe and Mennis 2012). This study compared vegetation density and crime rate using several factors, including the incidence of poverty, population density, and education attainment to create graduated color maps which allow researchers to determine if the amount of vegetation has an effect on crime rate. The Normal Difference Vegetation Index (NDVI), a remote sensing vegetation index derived from remotely sensed imagery, was used as a general measure of vegetation or concentration of healthy green vegetation (Wolfe and Mennis 2012). Graduated color maps or choropleth maps help reveal the spatial distribution of aggravated assaults, thefts, robberies, and burglaries. The findings of this study suggest that vegetation lowers the crime rate for urban-associated crimes such as assaults, robbery, and burglary. In 2014, Wolfe and Mennis studied the effects of crime rate in the surrounding areas during the demolition of a massive housing development. This study focused on three periods (early demolition, half- demolition, and post demolition), the area demolished was known as Robert Taylor Homes (RTH). This area was one of the largest and densely populated high-rise public housing developments in the city,

with an estimated 27,000 in 28 sixteen-story high rises spanning several blocks The study concluded that with the demolition of that many housing units, the murder and robbery rate needed to go somewhere. The resulted hot spot maps and charts suggested there was a relationship between crime hot spots emerging in neighborhoods with high concentrations of former Robert Taylor Homes residents and cold spots emerging near the old site of Robert Taylor Homes development. Despite reduce crime occurrence, the crimes became more clustered in the districts directly south of Robert Taylor Homes area (Melsness and Weichelt 2014).

The studies that focused on rural communities were scant. Most relevant studies took place outside of the United States. Walter DeKeserdy defined rural communities as places with small population sizes/densities. Areas where people are more likely to "know each other's businesses" and "come into regular contact with each other," while having "mutual trust among neighbors combined with a willingness to act on behalf of the common good, specifically to supervise children and maintain public order" (DeKeseredy 2015). Vania Ceccato states "Crime in small communities can have a long-term effect on people's perceptions of risk and their quality of life. Because of this a more sensitive view of crime and perceived safety in rural areas, beyond stereotypes of 'big city problems' and with theories that can capture the nature of the social organization of rural communities" (Ceccato 2015). Rural crime has received little attention, because of this urbanized focus and a tendency to idealize over the rural landscape, and its opposition the urban underbelly (Carleton et al., 2014). Most of the studies used surveys to contact participants (Mawby 2015, Somerville et al., 2015). The consensus on the geographic context of rural crimes is that they take place in sparsely populated areas surrounded by open expanses of land.

2.3 Studies on the U.S. Forest Service (USFS) Land

Peer-reviewed articles on crime mapping of national forest lands are very limited compared with other crime mapping studies. There have been 14 articles relating to USFS law enforcement or crime mapping written between 2001 and 2016. Joanne F. Tynon, an assistant professor at Oregon State University, Deborah J. Chavez, a project leader and researcher at the USFS, Pacific Southwest Research Station in California, and Michael G. Wing, an assistant professor at Oregon State University, have written the majority of these articles (12 out of 14 in total). The majority of their research focuses on the four western most Forest Service regions, i.e., Region 3 (Arizona and New Mexico), Region 4 (Nevada, Idaho, and Wyoming), Region 5 (California), and Region 6 (Washington and Oregon). These studies will be summarized chronologically.

The first article published in 2001 examined whether violence and crime were real concerns on Western USFS lands (Tynon et al., 2001). Researchers conducted face-to-face interviews carried out at eight USFS sites in the western United States. They noted that interviewers used scripts to keep the conversation consistent. The research establishes that urban-associated crimes, drug activity, and the other crime category rose significantly at all eight locations. This study noted that " (We) currently do not have an adequate understanding of the nature and extent of crimes on public lands and how they may affect visitors and employee safety, we may find ourselves unprepared to manage for conflicts" (Tynon et al., 2001). Wing and Johnson concentrated on the recreation patterns of visitors in regards to timber cutting instead of crime mapping. Conducting surveys similar to the National Visitor Use Monitoring Survey carried out by the USFS, researchers conducted interviews, with forest visitors to see the most likely place for a timber cutting. With the use of maps, the visitor outlined the route of

travel through the forest. Utilizing these routes researchers could plot areas on less traveled road corridors, ensuring the forest loses none of its recreational value to timber sales (Wing and Johnson 2001).

In the first article published in 2006, Paciello estimated that illegally removal of stolen trees and forest products dollars from country's public land account for over one billion dollars. There are several types of timber theft. Commercial timber theft, from loggers harvesting trees not included in the timber contract and tree poaching, from individuals stealing a tree or group of trees (Paciello 2006). The research shows that the majority of timber thefts were from industrial logging companies. Wing and Tynon are among the pioneers of using spatial analysis to map crimes on the USFS land. Their work explicitly stated that "To our knowledge, no other published studies are using LEIMARS (Law Enforcement and Investigations Management Attainment Reporting System) for the spatial analysis of crime in a national forest setting" (Wing and Tynon 2006). Using the kernel density tool, they created hot spot maps of Forest Service Region 6 in Washington and Oregon. The research showed that crime hot spots tend to concentrate near populations centers, close to roads or in proximity to marine destinations (note: a significant portion of national forest land situates in Washington and Oregon is coastal). Joanne F. Tynon and Deborah J. Chavez concentrated on crime in the woods, using a case study and conducting field interviews to develop categories of crime that the national forest settings could utilize. This article was the first to utilized several categories of crime and become the standard for USFS crime analysis. The categories used in this study include urban-associated crimes (e.g., arson, domestic violence, gang activity), assaults (e.g., criminal damage, threats against personnel), drug activity (e.g., armed defense of crops, booby traps, marijuana cultivation), extremist and nontraditional groups (e.g., EarthFirst!, militias/supremacy groups,

motorcycle groups), and other (e.g., armed defense of forest products, dumping of chemicals, dumping of household waste and landscape materials) (Tynon and Chavez 2006). This study uses a qualitative approach by conducting interviews of USFS personnel within Forest Service Region 4 (Idaho, Nevada, and Wyoming). Chavez and Tynon concentrated on violence and crime on national forests in necessary and long overdue (Tynon and Chavez 2006).

In 2008, as a revisit of a previous article (Wing and Tynon 2006), researchers analyzed crime patterns of national forest lands in Washington and Oregon. The researchers used geospatial analytical techniques including quadrat analysis, nearest neighbor analysis (NNA), nearest neighbor hierarchical (NNH) clustering, Kolmogorov–Smirnov (K–S) and variance–mean ratio tests to investigate spatial patterns and their statistical significance of crime incidents (Wing and Tynon 2008). These analysis tools were proven effective for shedding more light on previously gathered data.

In 2009 and 2010, two articles on the perception of USFS Law Enforcement (Chavez and Tynon 2009) and the role of law enforcement in the woods (Tynon et al., 2010), these studies utilized the same classification of crime mentioned above. These studies are both survey-based reports with a response rate of 73%. In 2003, there were 460 uniformed officers (LEOs) and 120 special agents for 191 million acres or about one officer per 329,000 acres (Stannard 2003; Tynon et al., 2010). That number went down in 2007 to 404 uniformed officers and 89 special agents (Chavez and Tynon 2007) as the forests has grown to 193 million acres or about one officer per 392,000 acres ("The U.S. Forest Service - An Overview" 2009). USFS land has increased by two million acres, while law enforcement personnel have decreased by 16%.

In a recent study, Pandit et al. (2016) concentrated on three specific types of crimes, fire crime, illegal timber logging crime, and occupancy use crime, on the Salem and Potosi Ranger

Districts of Mark Twain National Forest. Ripley's K-function (both univariate and bivariate) were utilized to identify potential spatial distribution between crime cases. This study also uses Buffer Zone Analysis to measure the distance from water and from roads to show how these features shape crimes being committed, based on the crime of opportunity theory. This theory is that it features, such as a water body or trail, bring more visitors to an area, that area will, in turn, see a rise in crime rate.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area

Southern Illinois lies between two major rivers, The Mississippi River to the West and the Ohio River to the East and South. While there is some debate as to what consists of Southern Illinois, this study focuses the 11 southernmost counties, including Alexander, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, Union, and Williamson. It has a population of approximately 344,000 of the 12,860,000 million people in Illinois or roughly 2.67 percent of the total population. Due in part to the lack of national economic hubs in its vicinity, there is roughly 15.8% of the population is within the poverty mark compared to 10.7% statewide. Since Southern Illinois University-Carbondale is located in the study area, the population swells during the school year (August – May) and decreases during the summer months (June- August). Geographically, Southern Illinois is much different from most of Illinois as it has relatively sparse farmland and its landscape dominated by rolling hills and sharp cliffs more typically suited for the Ozarks of Missouri. The climate of Southern Illinois is between a humid continental and humid subtropics with no large mountain or large bodies of water. The area is subject to both Arctic air in the winter and humid tropical air in the summer. The temperatures range on average between 21^{o}F in January and 90^{o}F in July; however, it is not rare to find it above 100^{o}F in the summer and below 0^{o}F in the winter for a day or two. As part of the Forest Service Region 9, the Shawnee National Forest (NF) spans approximately 280,000 acres with seven official designated wilderness areas within the Shawnee NF boundary (see Figure 1). There are 300 miles of marked trails for multi-use and 30 miles for hiker only. There are 1,250 miles of roads, 150 miles of streams, and 13 campgrounds in the area. The Shawnee NF is home

to more than 500 wildlife species, including 48 mammals, 237 birds, 52 reptiles, 57 amphibians, and 109 species of fish (Sierra Club, Illinois Chapter 2017). Within the Shawnee NF, the plant species are extremely diverse and range from sun-loving species to those that grow in dense shade. The tree cover dominates most publically owned land. Oak-hickory is the predominant timber type (Shawnee National Forest 2015) The Shawnee NF contains into two ranger districts, Hidden Springs Ranger District to the east (office in Vienna IL), Mississippi Bluffs Ranger District to the West (office in Jonesboro IL). Other offices include a Shawnee National Forest Supervisors Office (office in Harrisburg) that is open to the public, and two nonpublic centers: a Work Center in Murphysboro, and a Job Corps near Golconda.

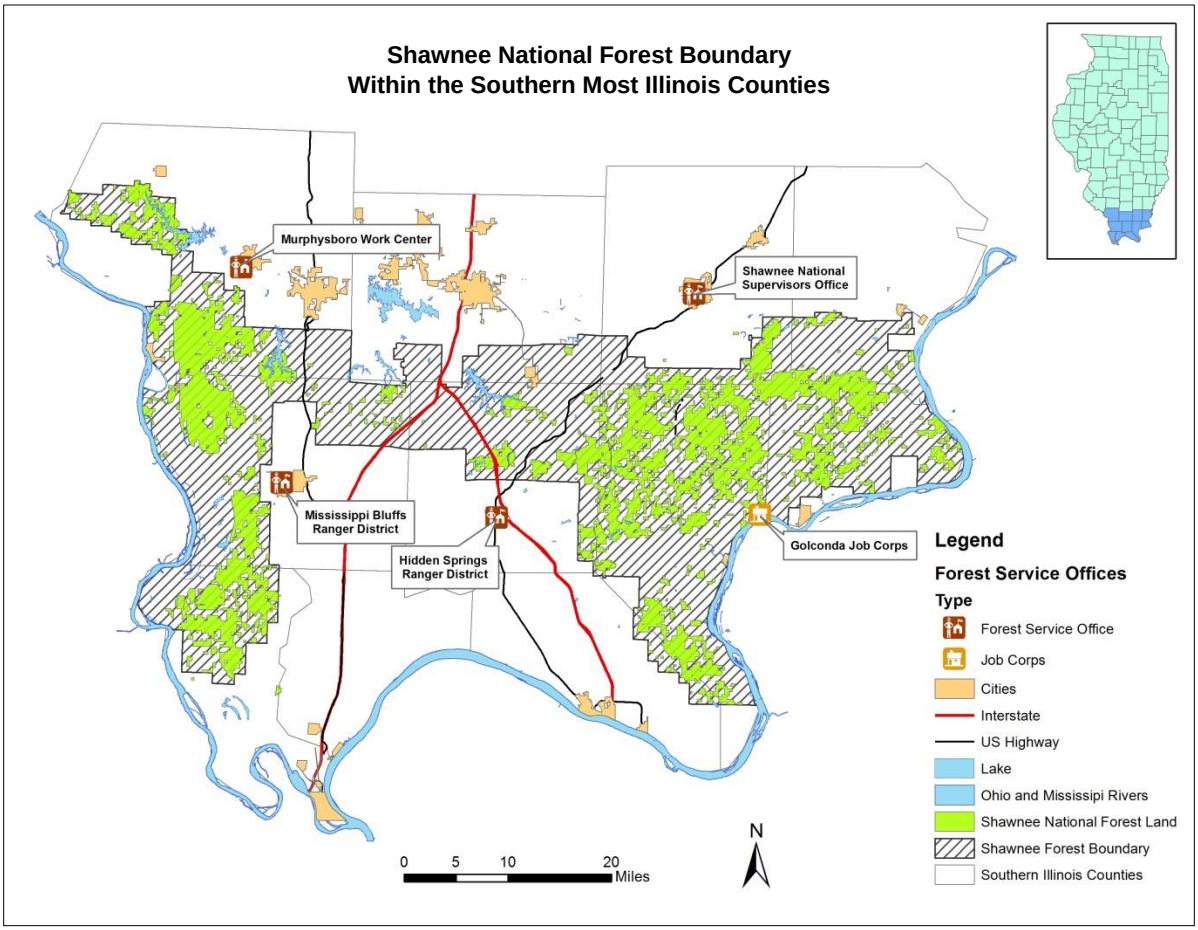


Figure 1: Shawnee National Forest Map

Job Corps are free education and training programs for young people age 16 to 24, who qualify as low income, to help learn a career, earn a high school diploma or GED, and find or keep a good job. These programs are residential, meaning students must live in the center's dormitories while completing their program (up to two years). Golconda Job Corps in Golconda Illinois has approximately 100-130 students each year, with a capacity of 180.

3.2 Data Sources

Most of the project related datasets were collected from the Shawnee National Forest GIS database, included projected shapefiles of forest boundaries, streams, system trails, water bodies, roads, and parking areas (Shawnee National Forest 2016). Roadways and county boundaries shapefiles of the 11 Southern Illinois counties were obtained from the Illinois Geospatial Data Clearinghouse (https://catalog.data.gov/dataset/2015-state-geodatabase-for-illinois). The crime data were collected in the Law Enforcement and Investigations Management Attainment Reporting Systems (LEIMARS) from the USFS Law Enforcement Officers (LEO) through a Freedom of Information Act (FOIA) request. Only the crimes occurred within the Shawnee National Forest boundaries were used for this study. A summary of the sources and details of the data is shown in Figure 1.

Table 1: The specification of the selected dataset

Data	Source	Details
Urban Codes	Office of Management and Budget (OMB) at http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx	Classification scheme that distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area

Data (cont.)	Source (cont.)	Reason/ information (cont.)
Shawnee GIS Database	https://www.cloudvault.usda.gov/public.php?service=files&t=24f93d114a71feb56e3e4f1beaa756fb	forest boundaries, trailheads, wilderness areas, system trails, streams, parking areas, and USFS roads
2015 Hydrography National Geodatabase	https://catalog.data.gov/dataset/2015-areal-hydrography-national-geodatabase	ponds, lake, swamps, rivers, streams
2015 Roads National Geodatabase	https://catalog.data.gov/dataset/2015-roads-national-geodatabase	primary, secondary, local neighborhood, and rural roads, city streets, vehicular trails , ramps, service drives, alleys, parking lot roads, private roads for service vehicles (logging, oil fields, ranches, etc.), bike paths or trails, bridle/horse paths, walkways/pedestrian trails, and stairways
Illinois State County Shapefile	https://catalog.data.gov/dataset/2015-state-geodatabase-for-illinois	County Shapefile
Crime Incident Data	Freedom Of Information Act (FOIA) Request (See Appendix A)	Crime incidences between 2009-2014 on the Shawnee National Forest used to locate hot spots and determine the correlation between location and the factors mentioned above

3.3 Crime Classification Scheme

The classification scheme in a crime research often depends on the geographic settings. In an urban setting, the classes include violent crimes (e.g., aggravated assault, aggravated battery, criminal sexual assault, murder, and robbery) and property crimes (e.g., burglary, larceny, motor vehicle theft, and arson) (Melsness and Weichelt 2014). Within USFS studies, there is a consensus among researchers that crime can be grouped into five separate categories: urban-associated crime, assaults, drug activity, extremist and nontraditional groups, and other (Chavez and Tynon 2000; Tynon et al., 2001; Tynon and Chavez 2006; Wing and Tynon 2006; Wing and Tynon 2008; Tynon et al., 2010). By analyzing the crime incidences provided by the USFS that

took place on the Shawnee NF, a new classification system was created to identify specific crimes based on the classification schemes used in previous studies. The classification used in the case study includes six different categories to distinguish between crime types, and leave out previous categories that have no incidences within the Shawnee NF.

Table 2: Compressive Breakdown of Classification

Total Number of Offenses	Classification	Explanation
53	**Assaults**	criminal property damage, threats against personnel, threats against property, threats against persons, physical altercations
250	**Drugs**	*alcohol violations*: violation where the individual was under the influence of or consuming alcohol illegally, *narcotic violations*: violation where the individual was under the influence of, consuming, in possession of or distributing illegal substances, and *other drug violation*
14	**Fire**	any arson cases, Fireworks
75	**Occupancy**	homeless people taking up residence in the forest, trespassing, closure orders/posted signs, dumping, sanitation and possession of weapon/firearm
145	**Wildlife/ Nature**	crimes against nature and wildlife, hunting or fishing violations, removal of forest products
448	**Other**	*ATV/UTV violations:* any violation that includes the use of an ATV or UTV; *Motor vehicle violations*- any violation that uses a motorized vehicle, including boats and motorcycle; *Compliance violations:* fee violations, failure to stop. *Other violations:* non-typical forest crimes, including deceased persons

Based on the above classification scheme and law enforcement regulation books were obtained from the USFS and Illinois State Police (White, 2015; US Government Publishing Office 2015), each violation was assigned to the corresponded category. Some violation codes (see Appendix B) do not match up to the above table. Mismatched crime incidents were examined and corrected if needed, based on the descriptions provided in the data. An example which occurred numerously, 36-CFR §261.58 T which states “Possessing, storing, or

transporting any part of a tree or other plant, as specified in the order" (US Government Publishing Office 2015) is used in many marijuana violations. 36-CFR §261.58 T would be classified as a nature/wildlife violation, however, for this specific example, marijuana is considered a plant, and therefore is classified as a drug violation (White, 2015; US Government Publishing Office 2015). Based on the above table, offenses were analyzed based on the separation of the corresponding season and violation classification.

3.4 Analysis

Several techniques are available to assist in the explanation of crime incident locations. Spatial statistics can address whether certain spatial patterns exist in the crime data. These patterns are described as occurring randomly or in clusters. The crime data were classified using the proposed classification scheme, and these classifications were the standard for all data analysis. All data projections referenced to the Universal Transverse Mercator (UTM) projected coordinate system, zone 16N with datum WGS 1983. The ESRI ArcMap was used to run analyses and to produce all maps within this report. In congruence with several studies, this study uses Average Nearest Neighbor, Kernel Density, Getis-Ord Gi, and Buffer Zone Analysis(Wing and Tynon 2006; Wing and Tynon 2008; Pandit et al. 2016) to determine the spatial and temporal patterns of reported crimes. Information from LEIMARS (Law Enforcement and Investigations Management Attainment Reporting System) includes not only date, time, incident, law enforcement number, and citation number, but also latitudes and longitudes, which serves as a Geospatial Information Systems (GIS) database facilitates spatial analysis (Wing and Tynon 2008). The following paragraphs discuss the academic background and application of each method within this study.

3.4.1 Average Nearest Neighbor (ANN)

Drawing inferences within spatial patterns within the Shawnee National Forest, the ANN analysis was employed to test if there is any spatial autocorrelation for the violation locations. We conducted this analysis for crimes grouped by different categories and seasons of the years. This analysis was used to determine significantly cluster patterns of the crimes reported on the Shawnee NF. The statistical significance of ANN results is determined by comparing the observed average distance by the expected average distance (Eq. 1).

$$ANN = \frac{\bar{D}_O}{\bar{D}_E} \quad (1)$$

Where ANN is Average Nearest Neighbor Index, $\bar{D}_O$ is the observed mean distance between two points and $\bar{D}_E$ is the expected mean distance.

$$\bar{D}_o = \frac{\sum_{i=1}^{n} d_i}{n} \quad (2)$$

$$\bar{D}_E = \frac{0.5}{\sqrt{n/A}} \quad (3)$$

Where d_i equals the distance between feature i and its nearest feature, n corresponds to the total number of features and A is the total study area. Once run ANN returns five values, observed mean distance, expected mean distance, nearest neighbor index, z-score, and p-value. The z-score and the p-value are used to determine whether to reject the null hypothesis or not. The null hypothesis is that there is no relationship between points. A low P-value indicates if there is a slight probability that the observed pattern is the result of random chance. Z-score is whether the crime location is equal to the mean and much above or below the average distance. One of the three types of spatial patterns will emerge from running the ANN, clustered, dispersed or random. A Z-score below -2.58 indicates significant clustering patterns exist for the location points.

Average Nearest Neighbor does not identify locations of clustering, but if there is clustering. Kernel Density Estimation is used to create a continuous surface representing the density of crimes distributed across the Shawnee NF.

3.4.2 Kernel Density

Kernel Density calculates the density of features in a specific area from point features using the kernel function to fit a smoothly tapered surface through each point. This estimation is used to make inferences about the population based on the sample data. Kernel Density analysis utilized category and season to most accurately portray crime occurred both spatially and temporally. The categories and time of year were used to locate point density across the Shawnee National Forest. Kernel Density Estimation is the approximation of the probability density function.

Next, the Getis-Ord Gi* Optimized Hot Spot Analysis was also run on the categories and season to make inferences about hot and cold spots located in the high-density areas. Both Kernel Density and Getis-Ord Gi* were utilized in visualizing type, amount, and locations of crimes committed in the Shawnee NF.

3.4.3 Getis-Ord Gi*

Getis-Ord Gi* calculates the hot spots for each feature in a dataset. The crime offense classification and the season of the offenses, Getis-Ord Gi* is used calculate a hot spot map for each. Hot spot analysis is utilized in this research to examine distributional patterns of various factors. Hot spot analysis works by looking at each feature in the context of neighboring features. Hot spots indicate high values of statistical significant.

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{s\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}} \qquad (4)$$

General speaking, x_j is the attribute value for feature *j*, $w_{i,j}$ is the spatial weight between feature *i* and *j*, *n* is equal to the total number of features and the Gi* statistic is a z-score, so no further calculations are required. (ESRI 2017).

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad (5)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2} \quad (6)$$

Optimized Hot Spot Analysis uses hot and cold spots to map clusters. Hot spots are significant clusters of high values or occurrences, where cold spots are significant clusters of low values or occurrences.

3.4.4 Buffer Zones Analysis

Buffer Zone Analysis creates distances from parking lots, trails, waterways, and roads to test whether the offenses occur with a higher frequency near areas with more human uses. As stated in several articles, crime hot spots tend to concentrate near populations centers, close to roads or in proximity to marine destinations (Pandit et al. 2016, Tynon and Chavez 2006, Wing and Tynon 2006, Wing and Tynon 2008). Creating buffer zones around certain features, we mapped locational frequencies of crime within distances from destinations. Generating buffer zones at 50, 100, 250, 500 feet and a ¼-mile around trails, parking lots, and lakes allows crimes in high use areas to be analyzed. These locations were picked as recreation areas, to test if the theory that crime happens near these sites more frequently than other places. Buffer Zones were utilized to show the amount of crime around highly visited areas.

CHAPTER 4

RESULTS AND DISCUSSION

The results fit into five sections of analysis: Average Nearest Neighbor, Kernel Density, Optimized Hot Spot Analysis (Getis-Ord Gi*), and Buffer Zone Analysis. All of the analyses will utilize crime categories and season to relate time of year. Buffer zone analysis determines the proximity to other factors such as roads and water bodies. The total number of incidences for this study was 985 crimes between FY 2009 and FY 2014.

4.1 Average Nearest Neighbor

Based on a fixed area of 9,016.461km^2 or 901,646.11ha, Average Nearest Neighbor was utilized to analyze the crimes under different classification categories and seasons and determine if the incidences showed clustering. The Average Nearest Neighbor analyses determined that the crimes under all classification categories and seasons on the Shawnee NF have statistically clustered patterns. Crimes in most categories show a z-score of -53.65, indicating less than 1% likelihood that the spatial patterns of these offenses were random. The offenses in the fire category differed slightly with a less than 5% chance of randomness. The crimes occurred at different seasons show the Z-scores ranging from -30.33 to -19.65 indicating less than 1% likelihood that the spatial patterns of these transgressions were random. Table 4 lists the Z-scores and P-values for each Average Nearest Neighbor analysis.

Table 3: Average Nearest Neighbor Z-Score and P-Value

Classification	Z-Score	P-value
All	-53.653095	0.00000
Assaults	-10.070551	0.00000
Drugs	-26.958034	0.00000
Fire	-2.361181	0.018217
Occupancy	-13.298177	0.00000
Wildlife/Nature	-18.337771	0.00000
Other	-35.585229	0.00000

Season	Z-Score	P-value
Winter	-19.654538	0.00000
Spring	-29.406843	0.00000
Summer	-30.331731	0.00000
Fall	-25.239668	0.00000

4.2 Kernel Density and Optimized Hot Spot Analysis

The Kernel Density Analysis displays locations of clusters using crime categories and seasonal classification. In correlation with Kernel Density, Optimized Hot Spot Analysis was used to predict hot spots accurately. In Figure 2, there are both cold and hot spots, which depict significant clustering of high occurrences and significant clustering of low occurrences. As

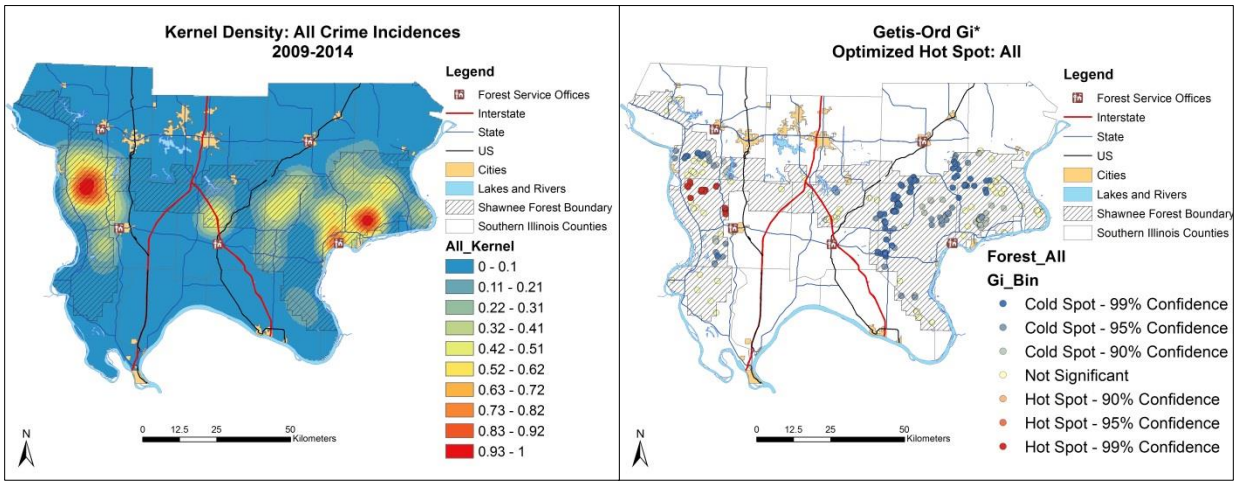


Figure 2: Kernel Density and Getis-Ord Gi* for All Crime
(See Appendix C, Figure 15 and 16)

mentioned above, kernel density locates hotspots where Getis-Ord Gi* locates and finds the magnitude of point clusters. Figure 2-7 showed the results of kernel density and optimized hot spot analyses. In Figure 3, in the southeastern area, there is a large cluster of assaults, located near Golconda Job Corps, with 44 out of 53 incidences happening within this area. In Figure 4,

the kernel density map shows the drug crimes concentrated around the western and eastern boundaries of the Shawnee NF, although the area in the west was dominated by "not significant" points according to the Getis-Ord Gi*. A "not significant" point is a location that is too far from other points, to be considered clustered. The eastern portion of the Shawnee NF shows high kernel density and 15 highly clustered points within occupancy crimes (Figure 5). In Figure 6, Wildlife and Nature related crimes show the best demonstration of cold spots that mirrors hot spots on the kernel density map. The optimized hot spot map shows a significant cold cluster on

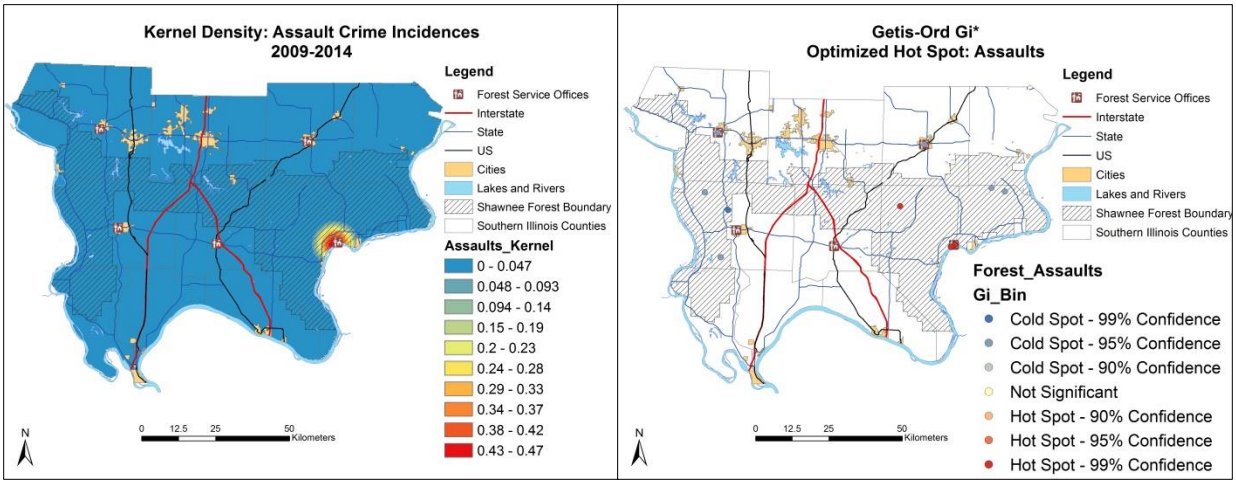


Figure 3: Kernel Density and Getis-Ord Gi* for Assaults
(See Appendix C, Figure 17 and18)

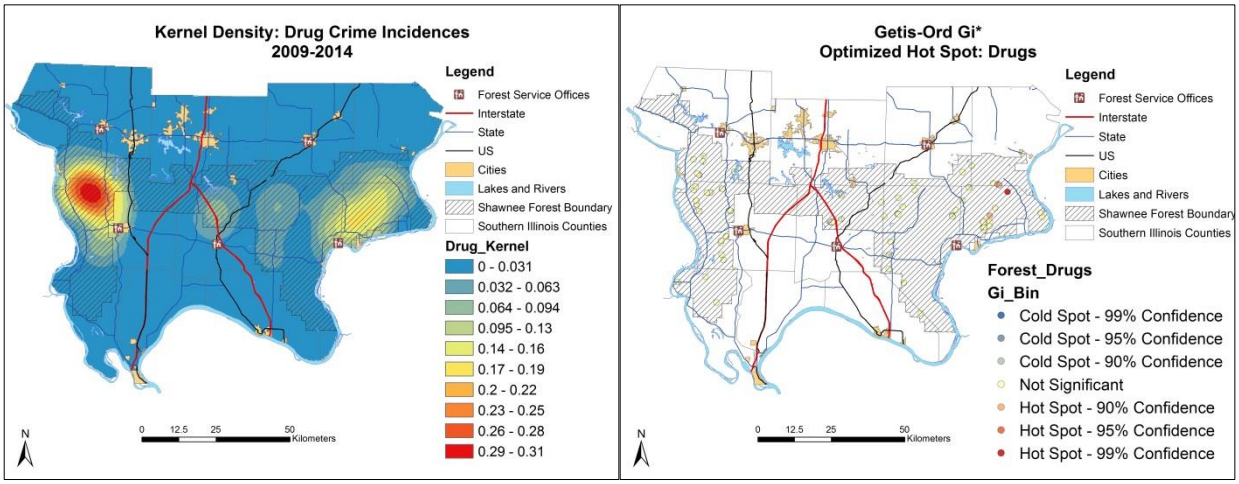


Figure 4: Kernel Density and Getis-Ord Gi* for Drugs
(See Appendix C, Figure 19 and 20)

the western portion of the area; these points are where 37 incidences took place over many different locations with the highest occurrence of three in any particular location. The hot spot in the middle of the region has a significant cluster of high occurrence takes place, while not as many incidences at only 28 incidences; the occurrence rate is much greater at 13 incidences in a single location. Figure 7 shows crimes under other category has three distinct hot spot locations. The first location is in the western part of the area, identified in several other categories as being a hot zone; it is a significant cluster of high occurrence points. The second hot spot on the kernel

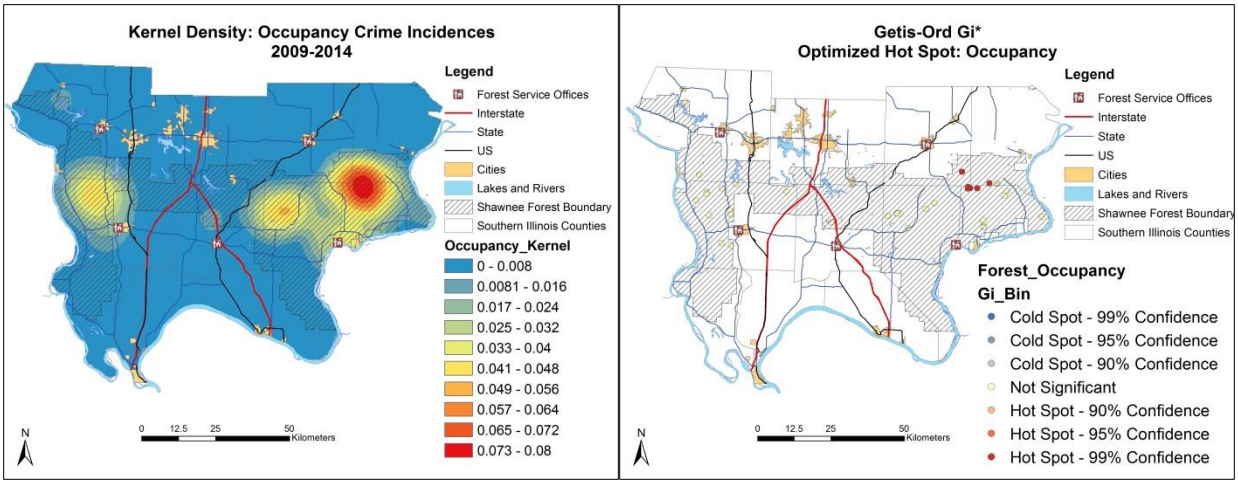


Figure 5: Kernel Density and Getis-Ord Gi* for Occupancy
(See Appendix C, Figure 22 and 23)

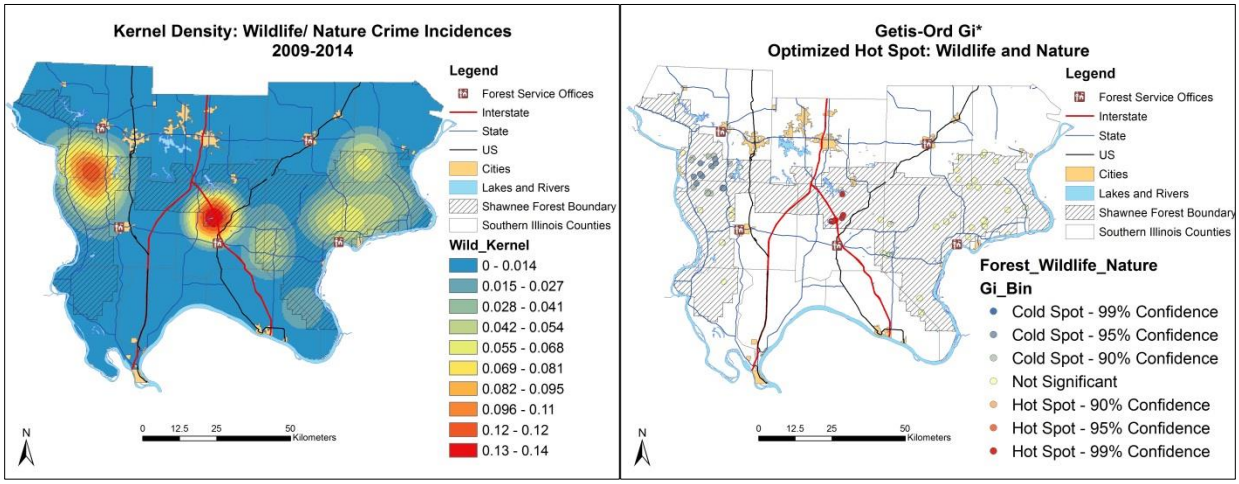


Figure 6: Kernel Density and Getis-Ord Gi* for Wildlife/Nature
(See Appendix C, Figure 24 and 25)

density map towards the middle of Southern Illinois is a significant cluster of low occurrence points. The third hot spot is a cluster of "not significant." This area is considered "not significant because the points are too far apart or there are not enough occurrences within this category. The other category saw the most incidences with 448 occurring within the study.

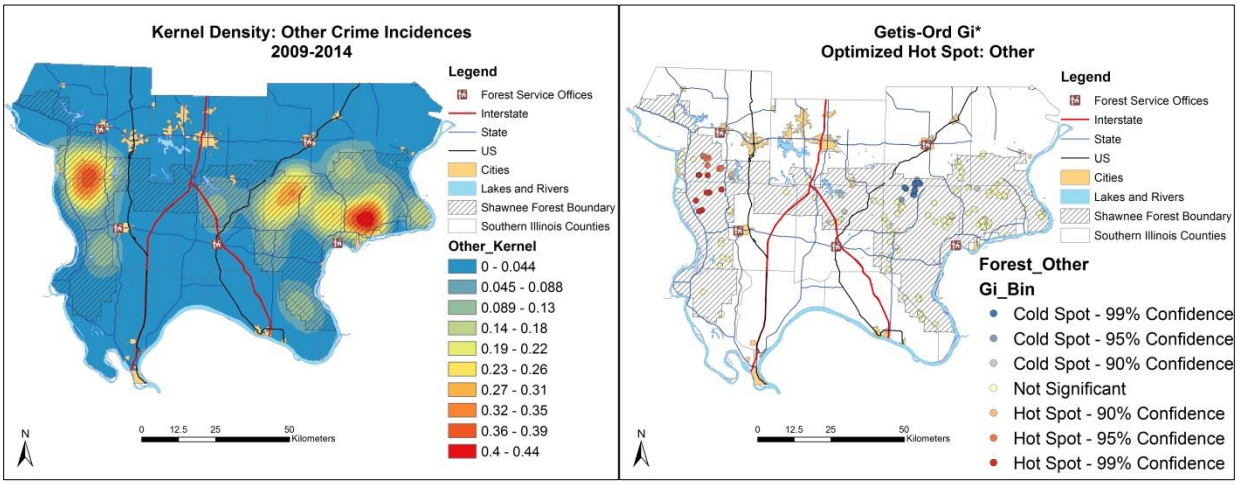


Figure 7: Kernel Density and Getis-Ord Gi* for Other (See Appendix C, Figure 26 and 27)

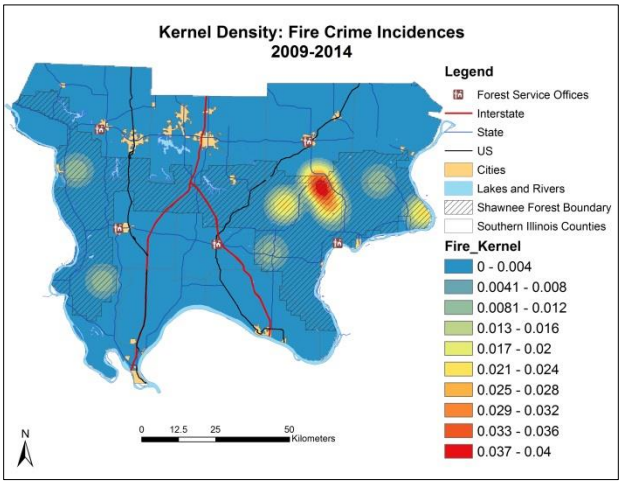


Figure 8: Kernel Density for Fire (See Appendix C, Figure 21)

Optimized Hot Spot Analysis requires at least 30 points to run successfully. Because the fire category is small, with only 14 points total, Getis-Ord Gi* analysis was not able to complete the analysis successfully. Kernel density was run to determine the general location of hot spots in

the area. This category required no further analysis as the number of incidences was insignificant.

Crimes under different seasons were analyzed to define areas of high crime density by the time of the year. Figure 9 shows the density for each season, the most common area is the western area found on several of the above maps. This portion of the map as several trails and parking lots there are also several hot spots on the eastern side of the area, one area, in particular,

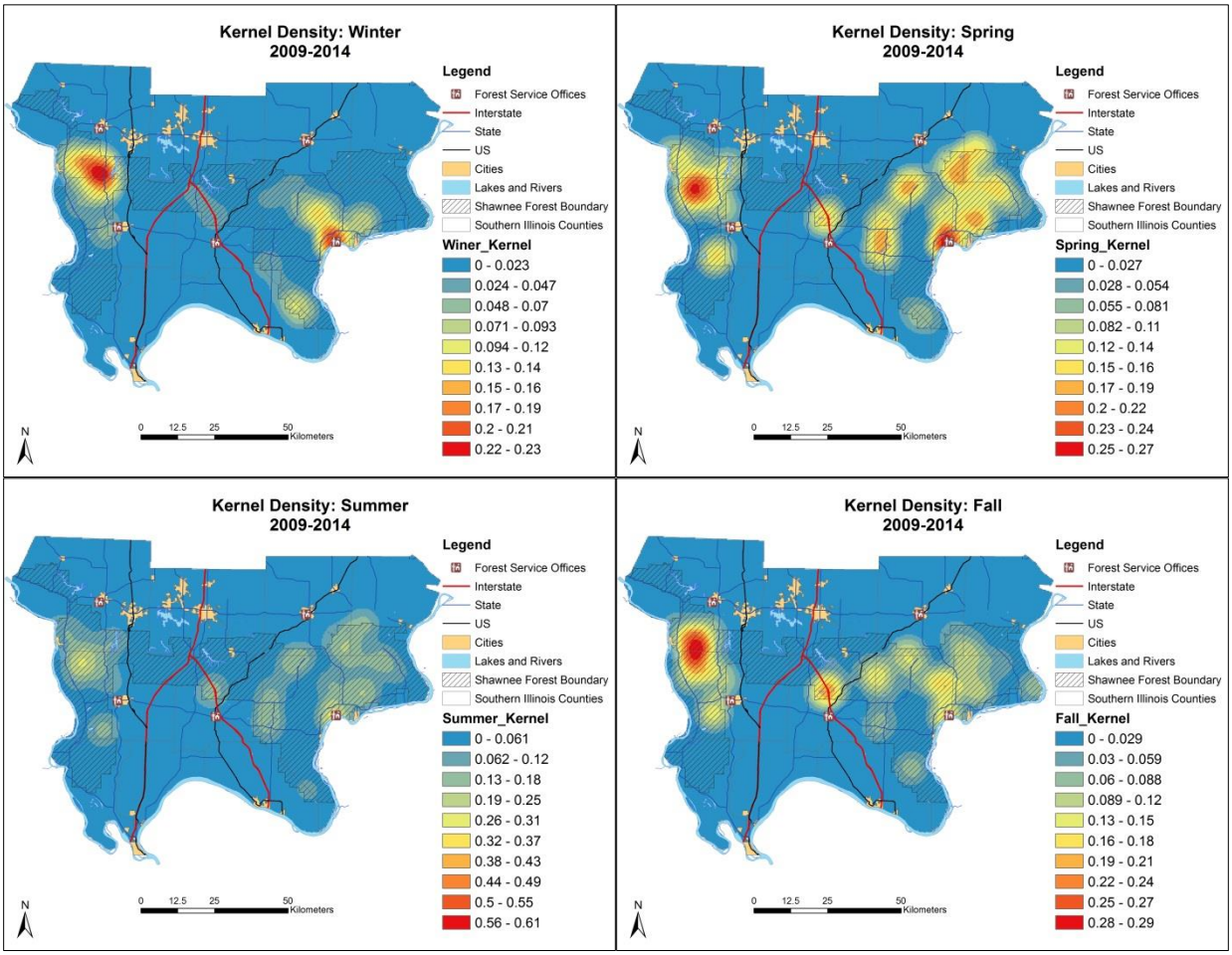


Figure 9: Kernel Density by Season (See Appendix C, Figure 28-31)

centers around Golconda Job Corps (Figure 1). This hot spot may be associated with an influx of a year-round population at the center. While summer has no distinct hot spots, this occurs because crimes were more widespread in the summer with 31.9% of all crime incidences going

on in the summer months, compared to 14.4% in the winter, 29.7% in the spring, and 23.8 happening in the fall (Figure 10). Spring begins the increase, as it starts to get warm in Southern Illinois and individual begin to recreate within the National Forest Boundary. Fall starts the decrease as the temperatures start decreasing. Spring and autumn are also higher as students from the University have relocated to the area for school. The warmer months see an increase in crime activity as opportunities to recreate outside increased.

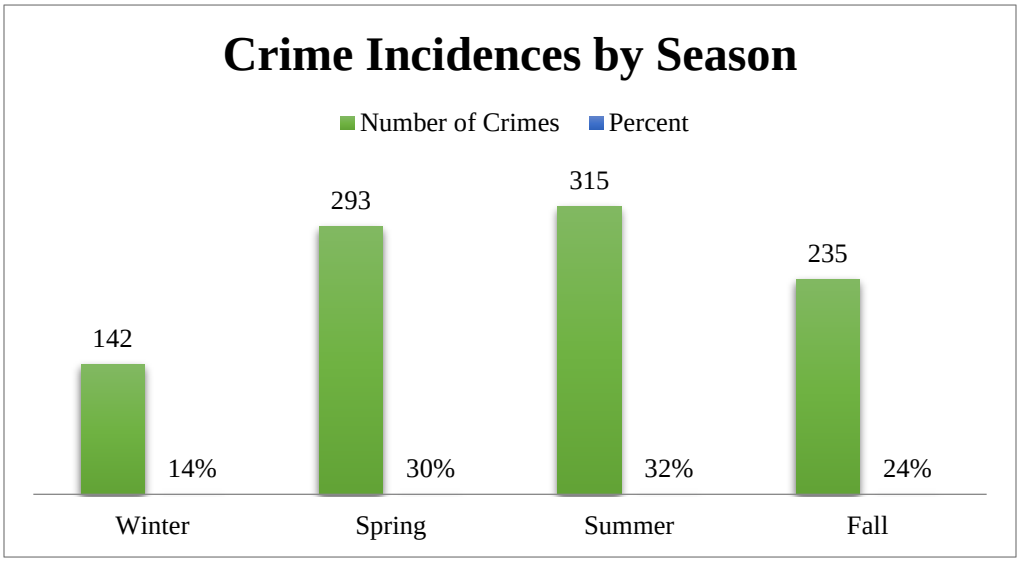
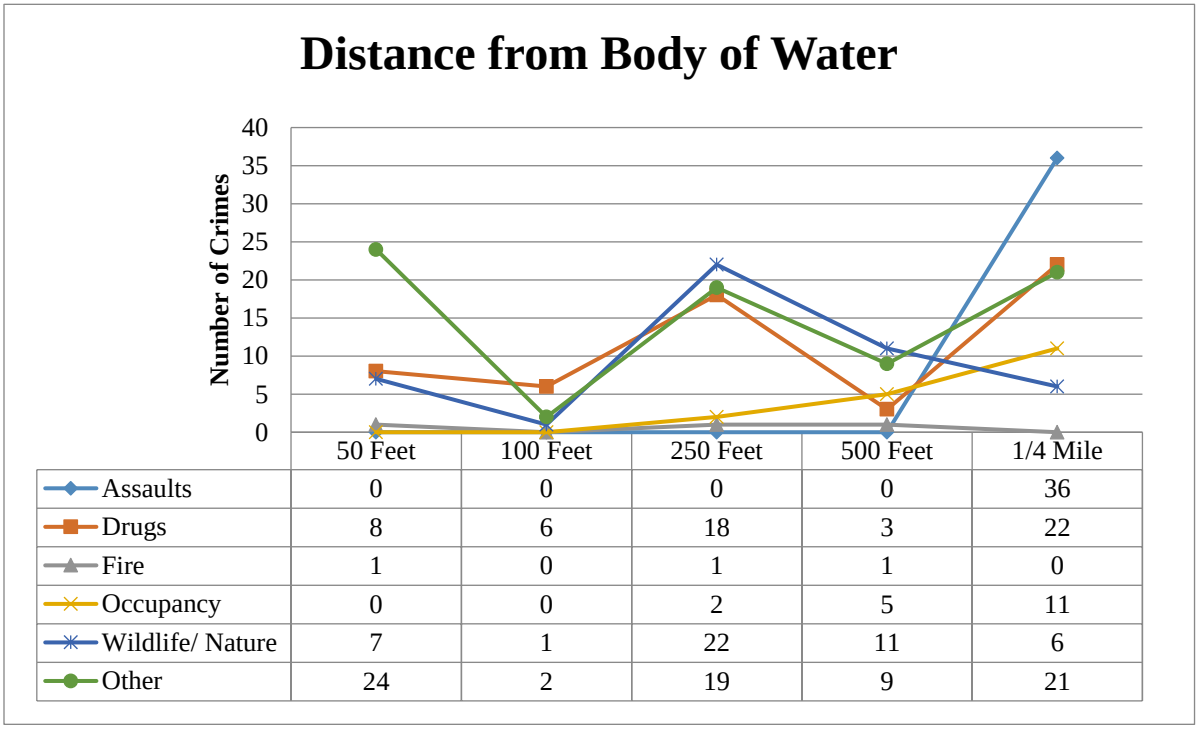


Figure 10: Crime Incidences by Season

4.3 Buffer Zone Analysis

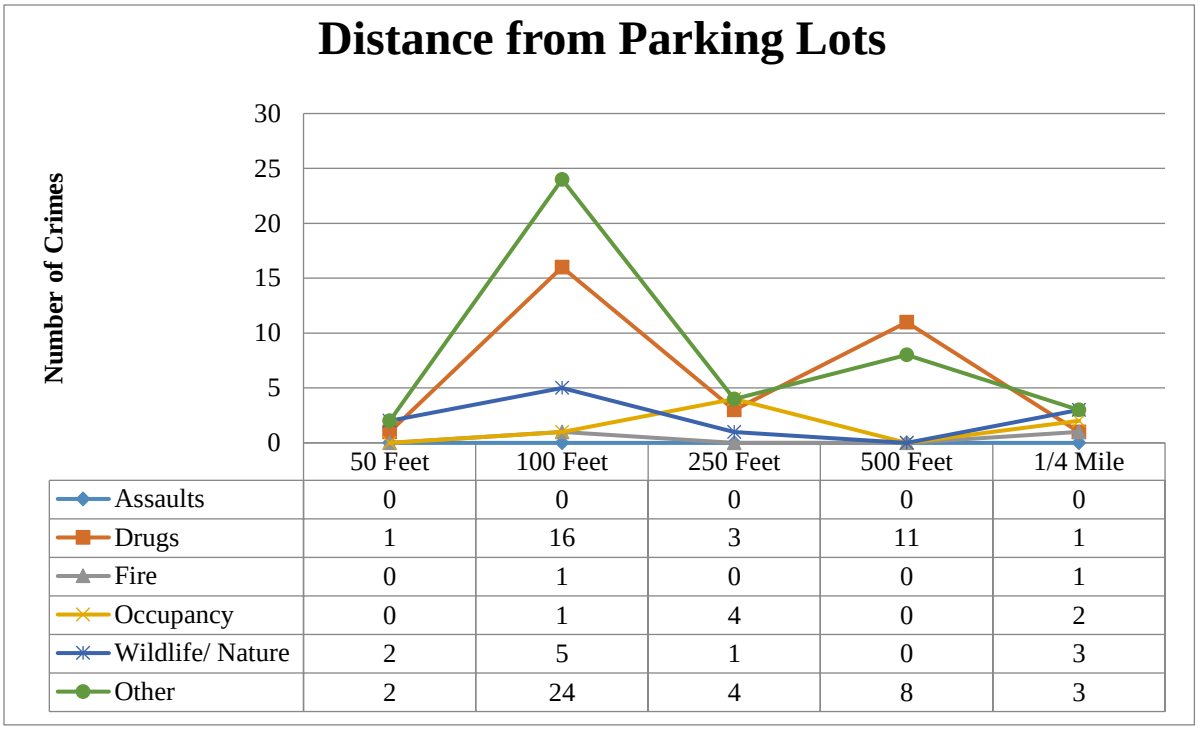
Through this analysis, crime typically focuses on road and trail corridors and adjacent to popular destination sites, such as waterways and parking lots, where visitor tend to gather. Buffer Zone Analysis developed five different distances (50 feet, 100 feet, 250 feet, 500 feet and 1,320 feet (1/4 mile)) near Motor Vehicle Use Map (MVUM) roads, bodies of water, trails, and parking lots. These areas were chosen because, with over 1200 miles of roads and 300 miles of trails, it would seem to reason that a majority of crime incidences happened in or around theses area. The area surrounding bodies of water, Figure 11, had 23.85% of all crime at 235 incidences. The

distribution around water bodies leans very close to the water at 50 feet or to the 250 feet mark. Parking areas, as shown in Figure 12, were found with an increase of crime activity at the 100 feet mark. The area around the parking lots also had a significant amount of incidences at 10.96% of offenses at 108 Incidences. Trails, Figure 13, buffer had 43.95%, or 433 crime incidences took place within ¼ from a trail. Roads, Figure 14, buffer zones have the most at 832 crime incidences, or 84.46 % of all incidences took place within ¼ mile from a road.



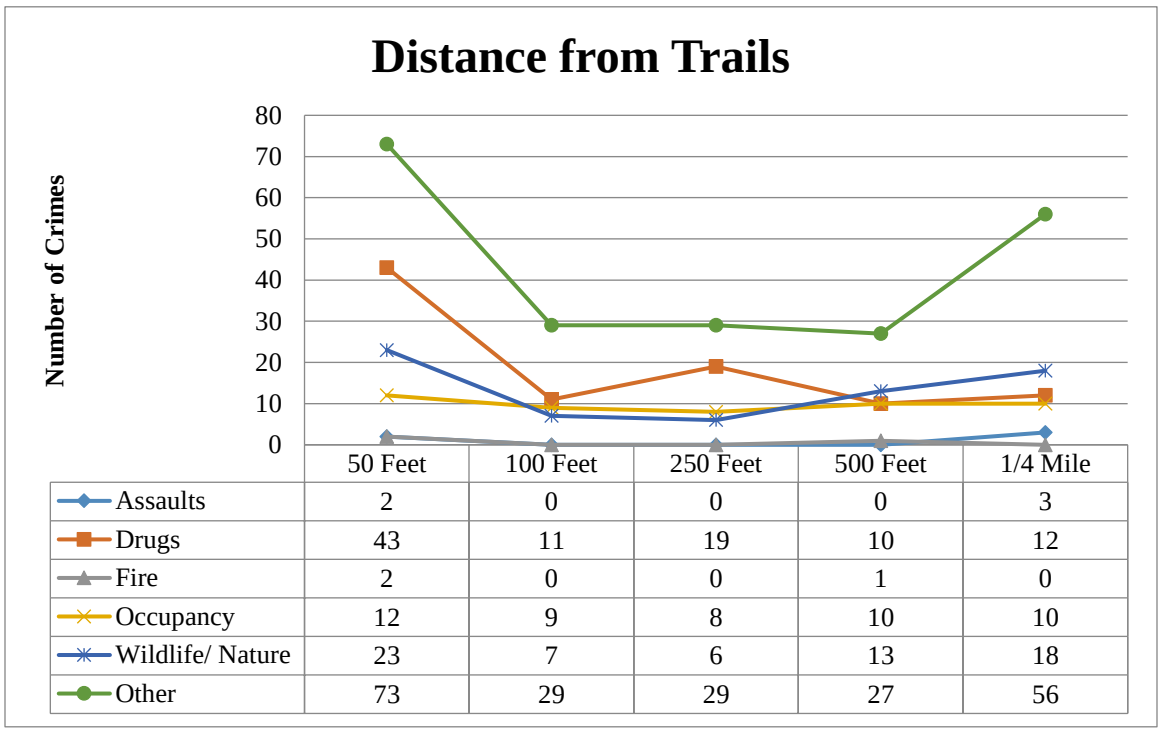
	50 Feet	100 Feet	250 Feet	500 Feet	1/4 Mile
Assaults	0	0	0	0	36
Drugs	8	6	18	3	22
Fire	1	0	1	1	0
Occupancy	0	0	2	5	11
Wildlife/ Nature	7	1	22	11	6
Other	24	2	19	9	21

Figure 11: Distance from Water



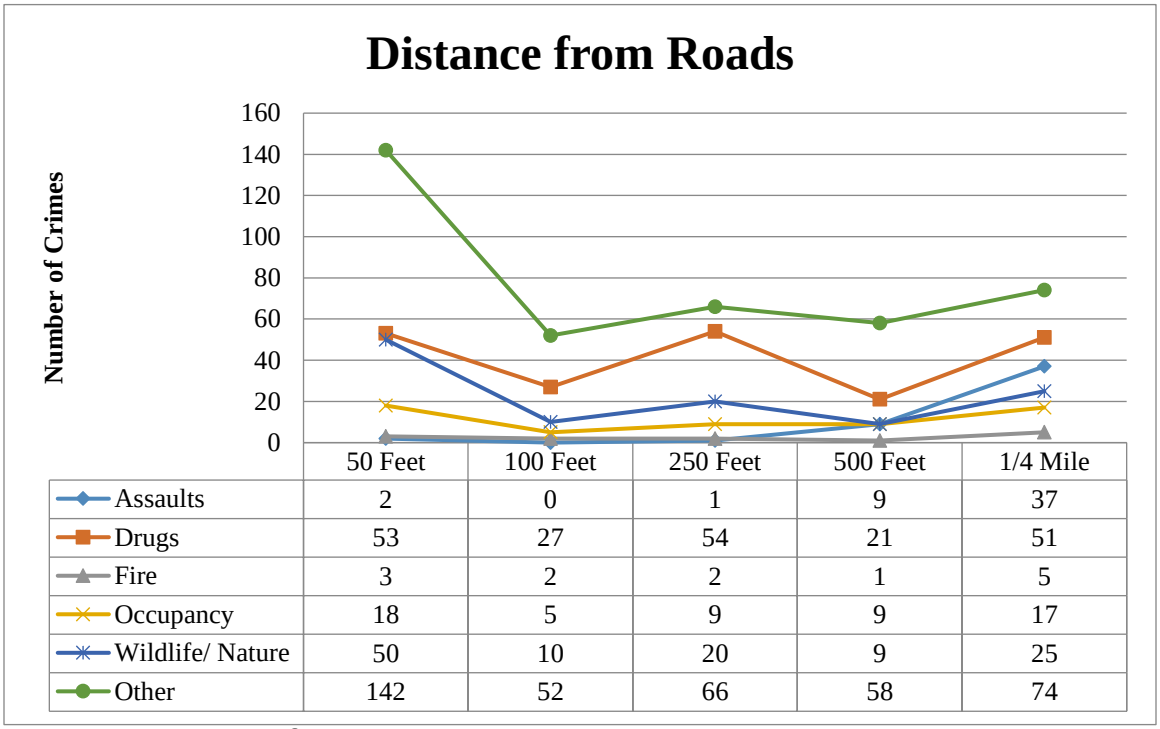
	50 Feet	100 Feet	250 Feet	500 Feet	1/4 Mile
Assaults	0	0	0	0	0
Drugs	1	16	3	11	1
Fire	0	1	0	0	1
Occupancy	0	1	4	0	2
Wildlife/ Nature	2	5	1	0	3
Other	2	24	4	8	3

Figure 12: Distance from Parking Lots



	50 Feet	100 Feet	250 Feet	500 Feet	1/4 Mile
Assaults	2	0	0	0	3
Drugs	43	11	19	10	12
Fire	2	0	0	1	0
Occupancy	12	9	8	10	10
Wildlife/ Nature	23	7	6	13	18
Other	73	29	29	27	56

Figure 13: Distance from Trails



	50 Feet	100 Feet	250 Feet	500 Feet	1/4 Mile
Assaults	2	0	1	9	37
Drugs	53	27	54	21	51
Fire	3	2	2	1	5
Occupancy	18	5	9	9	17
Wildlife/ Nature	50	10	20	9	25
Other	142	52	66	58	74

Figure 14: Distance from Roads

This study successfully used Average Nearest Neighbor, Kernel Density, Optimized Hot Spot Analysis (Getis - Ord Gi*), and Buffer Zone Analysis to analyze the patterns of crime occurrences on the Shawnee National Forest. By utilizing Average Nearest Neighbor, we were able to conclude that crimes occurred under different classification categories and season are were mostly clustered Running both Kernel Density and Optimized Hot Spot Analysis determined that major hot spots surround the far western portion of the Shawnee National Forest near several trails and parking lots. The eastern side of the forest near the supervisor's office also has many trails, which would create an influx of individuals frequenting the area. The last major hot spot is Golconda Job Corps; this may be due to many people living in the center full time. The hot spots were found to be around trailheads, parking areas, and water bodies. The Buffer Zone analysis found the spatial patterns of crimes are consistent with the similar finding in

previous research (Pandit et al. 2016, Wing and Tynon 2006). Areas around roads water bodies and trails show the majority of crime incidences.

This research is subject to a few limitations. Firstly, uncertainties associated with the attribute data entry and locations exist in the LEIMARS database. Human error can attribute to some of these mistakes through incorrect data entry, such as typing in wrong columns or missing records. The use of similar violation codes (Appendix B) can hamper the ability to analyze the data on a large scale, as manual reclassification was needed. Using Generalized locations can account for some error in analysis, such as at the entrance to the Job Corps, because of the generalized GIS points, using a generalized point instead of taking a new point of every incident, this practice may skew the data. Despite these problems, LEIMARS offers tremendous advantages over non-spatial databases.

Cataloging and analyzing crime incidents can provide law enforcement and managers a better overall picture of crime patterns. This paper identifies locations where crimes were prevalent and where the crime occurred with the greatest rate of recurrence. Management has several options to help mitigate offenses in the higher use areas. These options include: development of the sites, higher visited areas are less appealing to criminal activity. Adding physical barriers to areas of heavy off-road activities, which would lessen the off-road impact in sensitive areas. Control where parking and motor vehicles are permitted, this would reduce the number of visitors to a location. Increasing law enforcement or forest protection officers would provide a deterrent to criminal deviants. Having traffic checkpoints around the area during high use time such as weekends and holidays. Creating a more visible present, this means having more uniformed employees working in the field would deter repeat offenders. Lastly temporary or permeant closures of high violation sites would significantly reduce the numbers of violations in certain areas(Chavez, Tynon, and Knap 2004). While these are not new ideas, the Forest Service in recent years has seen an

increase in crime and a decrease of law enforcement and employees. While the USFS has been compiling the LEIMARS database for some time, but there has been little development in modeling these spatially referenced crimes.

CHAPTER 5

SUMMARY

Compared with urban crime studies, research on crimes and violence occurred in national forests is relatively scant albeit necessary. Understanding the spatial and temporal distribution of crimes and their explanatory factors is important to develop coping strategies and allocate resources to prevent the crimes. This study investigates the spatial and temporal patterns of the crimes in Shawnee National Forest during 2009-2014 based on data gathered through the Law Enforcement and Investigations Management Attainment Reporting System.This study demonstrates several techniques used to map crime. The three questions this paper answered were first, the amount and types of offenses being committed on the Shawnee, second, the spatiotemporal patterns of these crimes, and lastly, the management strategies that should be developed to help mitigate crimes in the forest areas. Answering the first question with the specific classification by dissolving each violation codes of the 985 total number of violations into six categories based on both the code and description of crime (Table 2). The second question regarding location and patterns of crimes utilized Nearest Neighbor Analysis, Kernel Density Estimation and Getis-Ord Gi*; the analyses discovered that crime in the Shawnee NF is very clustered concentrating on areas of high use such as USFS roads, trails, water bodies, and parking areas. The buffer zone analysis determined that 673 violations occur within a ¼ mile of one of these destination areas or 68% of all crimes. Summer saw the most incidences of crime at 315 incidences. Meaning 32% of all crime happened in the summer months. Lastly, question three was answered the results as crimes.

The application of GIS to crimes occurring on USFS land is relatively new. By examining the spatial distribution of LEIMARS crime incidents, we can produce a visualization

of information and correlation with factors, such as nearness to roads, water, or trails. By conducting spatial analyses, influential factors can be properly identified and examined. The results showed crime hot spots center around areas of interest including lakes and trails. There is also a strong correlation near transportation corridors. These destination areas usually attract more visitors; because of this, high-interest areas also see a higher numbers of crimes.

Future research should include, more sophisticated crime analysis might address geographic profiling and crime forecasting. The USFS might compare crime data in adjacent non-Forest Service areas, expanding with data to include state and local police data. While it was out of the scope of this report, one might find that there are localized hot spots around or within the forest boundary investigated by either state or local police and not the USFS. Examination of temporal crime patterns could suggest more detailed recommendation of the possibly of future crime. Lastly, based on the data used in this analysis, niche modeling or logistical regression modeling techniques could be potentially applied to develop a predictive model for crime occurrence

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APPENDICES

Appendix A:

USDA United States Department of Agriculture | Forest Service | Eastern Region Law Enforcement and Investigations | 626 East Wisconsin Avenue Suite 101 Milwaukee, WI 53202 414-297-3600

File Code: 6270
Date: February 2, 2016

Kristyn Stauber
1000 Faner Drive, Mail Code 4514, Room 4542
Carbondale, IL 62901

Dear Ms. Stauber:
This is our response to your Freedom of Information Act (FOIA) request 2016-FS-R9-01178-F that was received in this office on November 12, and perfected on December 1. You are requesting access to crime data from the Shawnee National Forest from 2009 to 2014.

The Eastern Region Law Enforcement & Investigations Unit conducted a reasonable search and identified 14 pages of records as responsive to your request. These documents are being released in entirety and have been delivered via electronic mail to kstauber@siu.edu.

Fees

Pursuant to Title 7 Code of Federal Regulations (CFR), Subtitle A, Part 1, Subpart A, Appendix A, the FOIA allows for the assessment of search and duplication costs. The first 100 pages of duplications and 2 hours of research time are provided free of charge. Therefore, no fees are associated with this request.

Appeal Rights

The FOIA provides you the right to appeal my decision to your FOIA request. Any appeal must be made in writing, within 45 days from the date of this letter, to the Chief, USDA's Forest Service:

- by email to wo_foia@fs.fed.us; or
- by regular mail to Mail Stop 1143, 1400 Independence Avenue, SW, Washington, D.C. 20250-1143; or
- by Fed Ex or UPS to 201 14th Street SW, ORMS, FOIA Service Center, Floor 1 CEN, Washington, D.C. 20250-1143; or
- by fax at (202) 205-1542.

The term "FOIA APPEAL" should be placed in capital letters on the subject line of the email or on the front of the envelope. To facilitate the processing of your appeal, please include a copy of this letter and/or the FOIA case number 2016-FS-R9-01178-F assigned to your FOIA request.

This concludes our response and we appreciate the extension which you granted. If you have any questions or concerns, please contact Danielle Hegler Wooten, Regional FOIA Coordinator, at 404-347-5235 or dhegler@fs.fed.us.

Sincerely,

MARY KING
Special Agent in Charge

cc: Danielle Hegler Wooten, Michael Clemens

Appendix B: This table is to be used as a general guide, depending on the description of the actual data some of the classifications needed to be changed All items in this table were gathered using the law enforcement regulation code books. (White, 2015; "eCFR — Code of Federal Regulations" 2015)

OFFENSE_ CODE	Classification- 2 Assaults, 3 Drug/alcohol 4 Wildlife, 5 Occupancy, 6 Fire, 7 Other	GENERAL	SPECIFIC
16USC1540	4	Endangered Species	
18USC13	7	Sec. 13 - Laws of States adopted for areas within Federal jurisdiction	
18USC1855	6	Sec. 1855 - Timber set afire	
18USC2252	2	Sec. 2252 - Certain activities relating to material involving the sexual exploitation of minors	(1) knowingly transports or ships using any means or facility of interstate or foreign commerce or in or affecting interstate or foreign commerce by any means including by computer or mails, any visual depiction, if (A) the producing of such visual depiction involves the use of a minor engaging in sexually explicit conduct; and (B) such visual depiction is of such conduct
21USC841	3	Sec. 841 - Prohibited acts A	(1) to manufacture, distribute, or dispense, or possess with intent to manufacture, distribute, or dispense, a controlled substance; or (2) to create, distribute, or dispense, or possess with intent to distribute or dispense, counterfeit substance.
21USC841A			
36CFR2613A	2	261.3 Interfering with a Forest officer, volunteer, or human resource program enrollee or giving a false report to a Forest officer.	(a) Threatening, resisting, intimidating, or interfering with any forest officer engaged in or on account of the performance of his official duties in the protection, improvement, or administration of the National Forest System is prohibited.

36CFR2613C	2	261.3 Interfering with a Forest officer, volunteer, or human resource program enrollee or giving a false report to a Forest officer.	(c) Threatening, intimidating, or intentionally interfering with any Forest-officer, volunteer, or human resource program enrollee while engaged in, or on account of, the performance of duties for the protection, improvement, or administration of the National Forest System or other duties assigned by the Forest Service.
36CFR2614A	2	261.4 Disorderly conduct	(a) Engaging in fighting.
36CFR2614B			(b) Addressing any offensive, derisive, or annoying communication to any other person who is lawfully present when such communication has a direct tendency to cause acts of violence by the person to whom, individually, the remark is addressed.
36CFR2614C			(c) Make statements or other actions directed toward inciting or producing imminent lawless action and likely to incite or produce such action.
36CFR2614D			(d) Causing public inconvenience, annoyance, or alarm by making unreasonably loud noise.
36CFR2615A	6	261.5 Fire	(a) Carelessly or negligently throwing or placing any ignited substance or other substance that may cause a fire.
36CFR2615E			(e) Causing and failing to maintain control of a fire that is not a prescribed fire that damages the National Forest System.
36CFR2616A	4	261.6 Timber and other forest products	(a) Cutting or otherwise damaging any timber, tree, or other forest product, except as authorized by a special-use authorization, timber sale contract, or Federal law or regulation.

36CFR2616H	4	261.6 Timber and other forest products	(h) Removing any timber, tree or other forest product, except as authorized by a special-use authorization, timber sale contract, or Federal law or regulation.
36CFR2617A	7	261.7 Livestock	(a) Placing or allowing unauthorized livestock to enter or be in the National Forest System or other lands under Forest Service control.
36CFR2618A	4	261.8 Fish and wildlife	(a) Hunting, trapping, fishing, catching, molesting, killing or having in possession any kind of wild animal, bird, or fish, or taking the eggs of any such bird.
36CFR2619A	2	261.9 Property	(a) Damaging any natural feature or other property of the United States.
36CFR2619B			(b) Removing any natural feature or other property of the United States.
36CFR2619D			(d) Removing any plant that is classified as a threatened, endangered, sensitive, rare, or unique species.
36CFR26110A	5	261.10 Occupancy and use	(a) Constructing, placing, or maintaining any kind of road, trail, structure, fence, enclosure, communication equipment, significant surface disturbance, or another improvement on National Forest System lands or facilities without a special-use authorization, contract, or approved operating plan when such authorization is required.
36CFR26110B			(b) Construction, reconstructing, improving, maintaining, occupying or using a residence on National Forest System lands unless authorized by a special-use authorization or approved operating plan when such authorization is required.

36CFR26110C	5	261.10 Occupancy and use	(c) Selling or offering for sale any merchandise or conducting any kind of work activity or service unless authorized by Federal law, regulation, or special-use authorization.
36CFR26110D			d) Discharging a firearm or any other implement capable of taking human life, causing injury, or damaging property as follows: (1) In or within 150 yards of a residence, building, campsite, developed recreation site or occupied area, or (2) Across or on a National Forest System road or a body of water adjacent thereto, or in any manner or place whereby any person or property is exposed to injury or damage as a result in such discharge. (3) Into or within any cave.
36CFR26110F			(f) Placing a vehicle or other object in such a manner that it is an impediment or hazard to the safety or convenience of any person.
36CFR26110I			(i) Operating or using in or near a campsite, developed recreation site, or over an adjacent body of water without a permit, any device which produces noise, such as a radio, television, musical instrument, motor or engine in such a manner and at such a time so as to unreasonably disturb any person.
36CFR26110J			(j) Operating or using a public address system, whether fixed, portable or vehicle mounted, in or near a campsite or developed recreation site or over an adjacent body of water without a special-use authorization.
36CFR26110L			(l) Violating any term or condition of a special-use authorization, contract or approved operating plan.

36CFR26110M	5	261.10 Occupancy and use	(m) Failing to stop a vehicle when directed to do so by a Forest Officer.
36CFR26111B	5	261.11 Sanitation	(b) Possessing or leaving refuse, debris, or litter in an exposed or unsanitary condition.
36CFR26111C			(c) Placing in or near a stream, lake, or other water any substance which does or may pollute a stream, lake, or other water.
36CFR26111D			(d) Failing to dispose of all garbage, including any paper, can, bottle, sewage, waste water or material, or rubbish either by removal from the site or area or by depositing it into receptacles or at places provided for such purposes.
36CFR26111E			(e) Dumping of any refuse, debris, trash or litter brought as such from private property or from land occupied under permit, except, where a container, dump or similar facility has been provided and is identified as such, to receive trash generated from private lands or lands occupied under permit.
36CFR26112A	4	261.12 National Forest System roads and trails	(a) Violating the load, weight, height, length, or width limitations prescribed by State law except by special-use authorization or written agreement or by order issued under §261.54 of this Chapter.
36CFR26112C			(c) Damaging and leaving in a damaged condition any such road, trail, or segment thereof.
36CFR26113	7	261.13 Motor vehicle use	
36CFR26115A	7	261.15 Use of vehicles off roads	(a) Without a valid license as required by State law.
36CFR26115E			(e) While under the influence of alcohol or other drug;
36CFR26115H			(h) In a manner which damages or unreasonably disturbs the land, wildlife, or vegetative resources.
36CFR26116K	7	261.16 Developed recreation sites	(k) Bringing in or possessing in a swimming area an animal, other than a service animal.
36CFR26117	7	261.17 Recreation fees	Failure to pay any recreation fee is prohibited.

36CFR26118A	4	261.18 National Forest Wilderness	(a) Possessing or using a motor vehicle, motorboat or motorized equipment except as authorized by Federal Law or regulation.
36CFR26152F	6	special orders: § 261.52 Fire	(f) Possessing, discharging or using any kind of firework or other pyrotechnic device.
36CFR26153A	7	special orders: § 261.53 Special closures	When provided in an order, it is prohibited to go into or be upon any area which is closed for the protection of (a) Threatened, endangered, rare, unique, or vanishing species of plants, animals, birds or fish.
36CFR26153B			When provided in an order, it is prohibited to go into or be upon any area which is closed for the protection of (b) Special biological communities.
36CFR26153E			When provided in an order, it is prohibited to go into or be upon any area which is closed for the protection of (e) Public health or safety.
36CFR26153F			When provided in an order, it is prohibited to go into or be upon any area which is closed for the protection of (f) Property.
36CFR26154A	7	special orders: §261.54 National Forest System roads	(a) Using any type of vehicle prohibited by the order.
36CFR26154D			(d) Operating a vehicle in violation of the speed, load, weight, height, length, width, or other limitations specified by the order.
36CFR26154E			(e) Being on the road.
36CFR26154F			(f) Operating a vehicle carelessly, recklessly, or without regard for the rights or safety of other persons or in a manner or at a speed that would endanger or be likely to endanger any person or property.
36CFR26156	7	special orders: §261.56 Use of vehicles off National Forest System roads	
36CFR26158A	5	special orders: §261.58 Occupancy and use	(a) Camping for a period longer than allowed by the order.

36CFR26158AA	5	special orders: §261.58 Occupancy and use	(aa) Riding, hitching, tethering or hobbling a horse or other saddle or pack animal in violation of posted instructions.
36CFR26158BB	3		(bb) Possessing a beverage which is defined as an alcoholic beverage by State law.
36CFR26158CC	5		(cc) Possessing or storing any food or refuse, as specified in the order.
36CFR26158E			(e) Camping.
36CFR26158F			(f) Using a campsite or other area described in the order by more than the number of users allowed by the order.
36CFR26158G			(g) Parking or leaving a vehicle in violation of posted instructions.
36CFR26158K			(k) Entering or being in a body of water.
36CFR26158L			(l) Being in the area after sundown or before sunrise.
36CFR26158N			(n) Possessing or operating a motorboat.
36CFR26158T			(t) Possessing, storing, or transporting any part of a tree or other plant, as specified in the order.
36CFR26158V			(v) Hunting or fishing.
FSM6500		Finance and Claims	
FSMHS53032		Coop Law	assisting other LE Agencies, no nexus to NFS or warrant
FSMHS670999	2	Fatality	
ILCS 625 5/3-401	7	Sec. 3-401. Effect of provisions.	Non-registered
ILCS 625 5/4-103	7	Sec. 4-103. Offenses relating to motor vehicles and other vehicles - Felonies.	
ILCS 625 5/11-1426.1	7	Sec. 11-1426.1. Operation of non-highway vehicles on streets, roads, and highways.	

ILCS 625 5/11-204.1	2	Sec. 11-204.1. Aggravated fleeing or attempting to elude a peace officer.	
ILCS 720550/4	3	Sec. 4. It is unlawful for any person knowingly to possess cannabis	
ILCS 720 550/4(B)	3	(b) more than 2.5 grams but not more than 10 grams of any substance containing cannabis is guilty of a Class B misdemeanor	
ILCS 720 570/210(B)	3	(b) The controlled substances listed in this Section are included in Schedule IV.	
ILCS 720600/3.5	3	Sec. 3.5. Possession of drug paraphernalia	
ILCS 720 646/60	3	Sec. 60. Methamphetamine possession.	
RSMO195.202	3	Missouri: Possession or control of a controlled substance, exception, penalty	

Appendix C: Maps

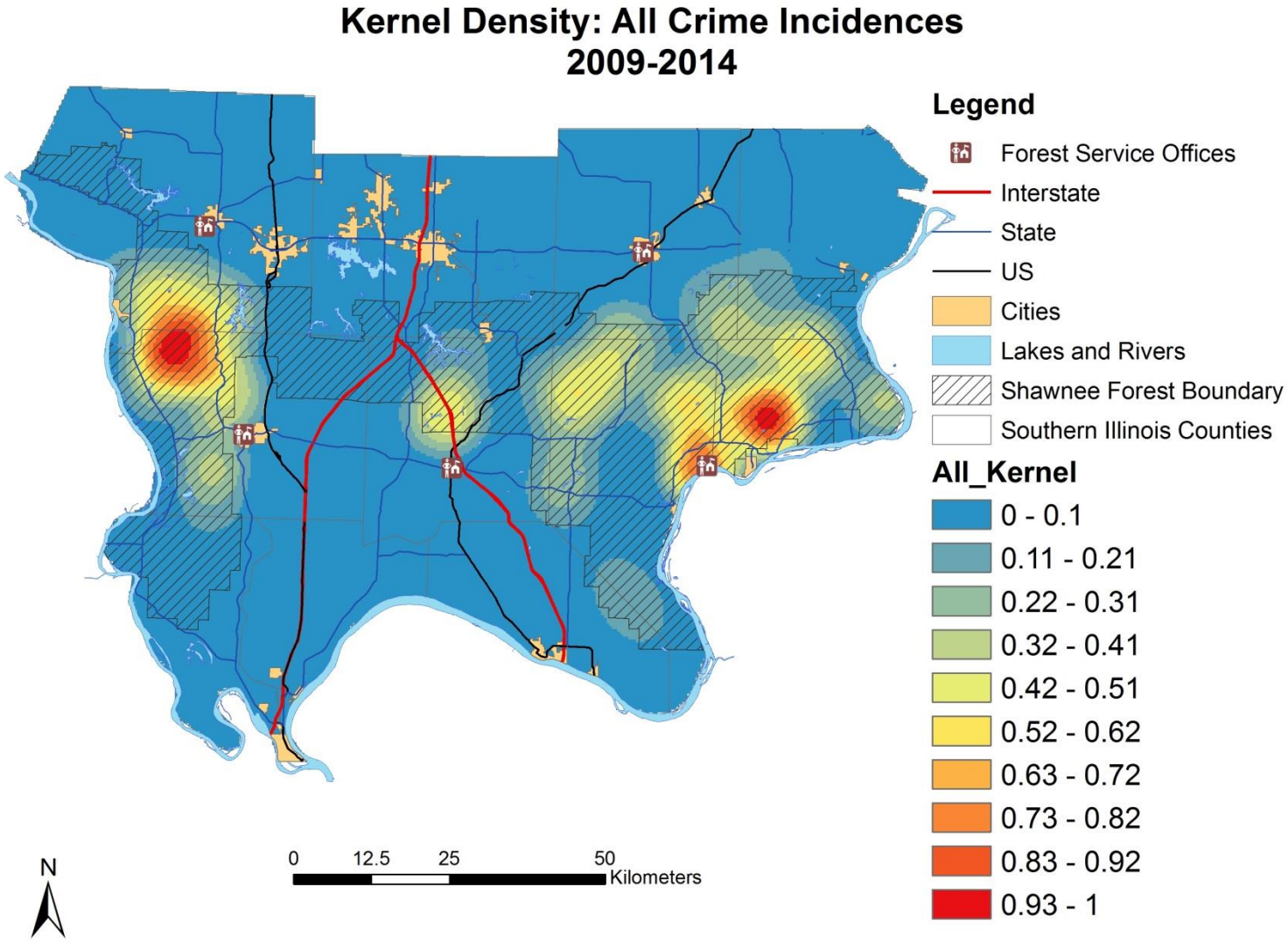

Figure 15: Kernel Density: All Crimes Enlarged

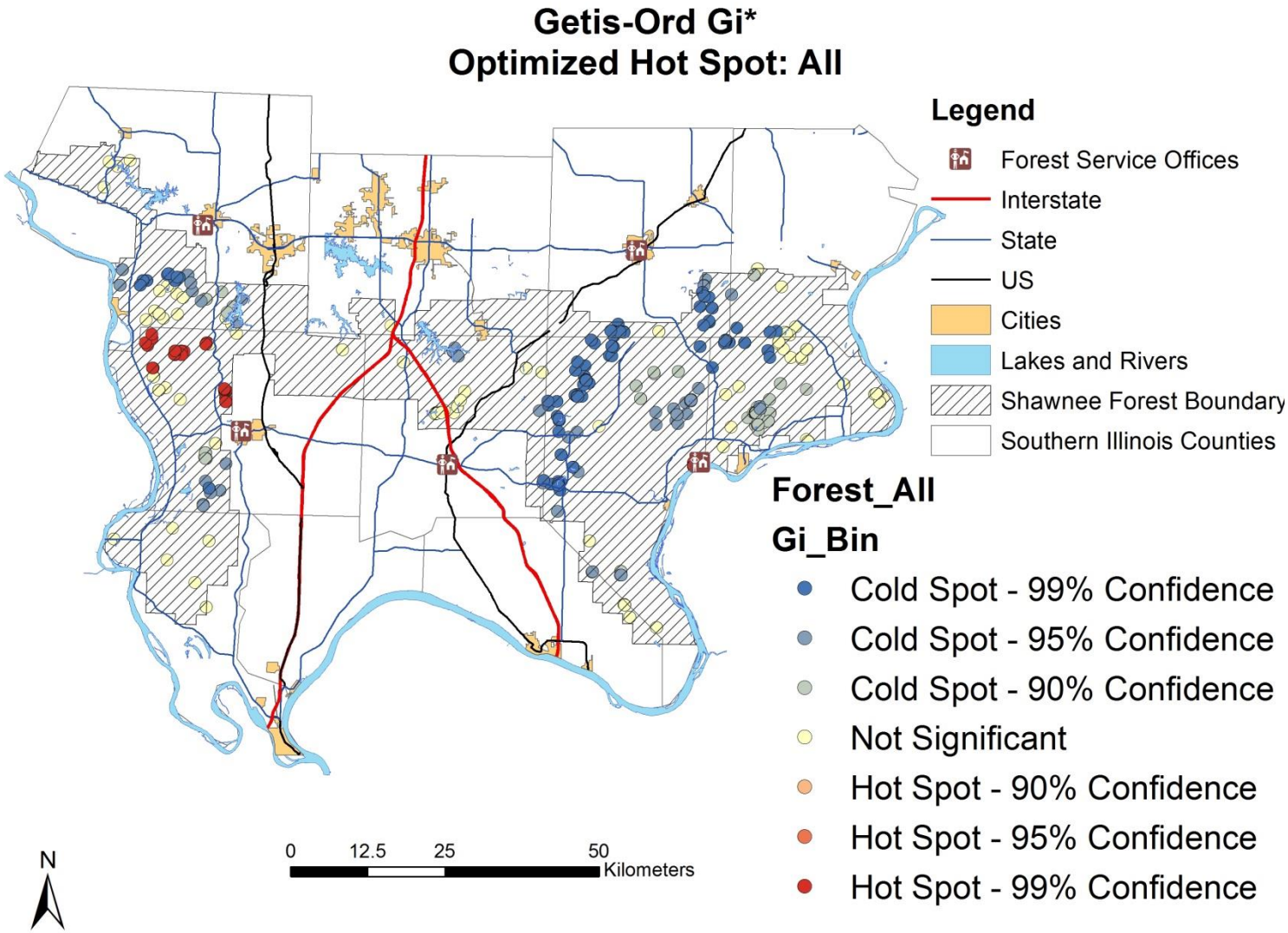

Figure 16: Getis-Ord Gi*: All Points Enlarged

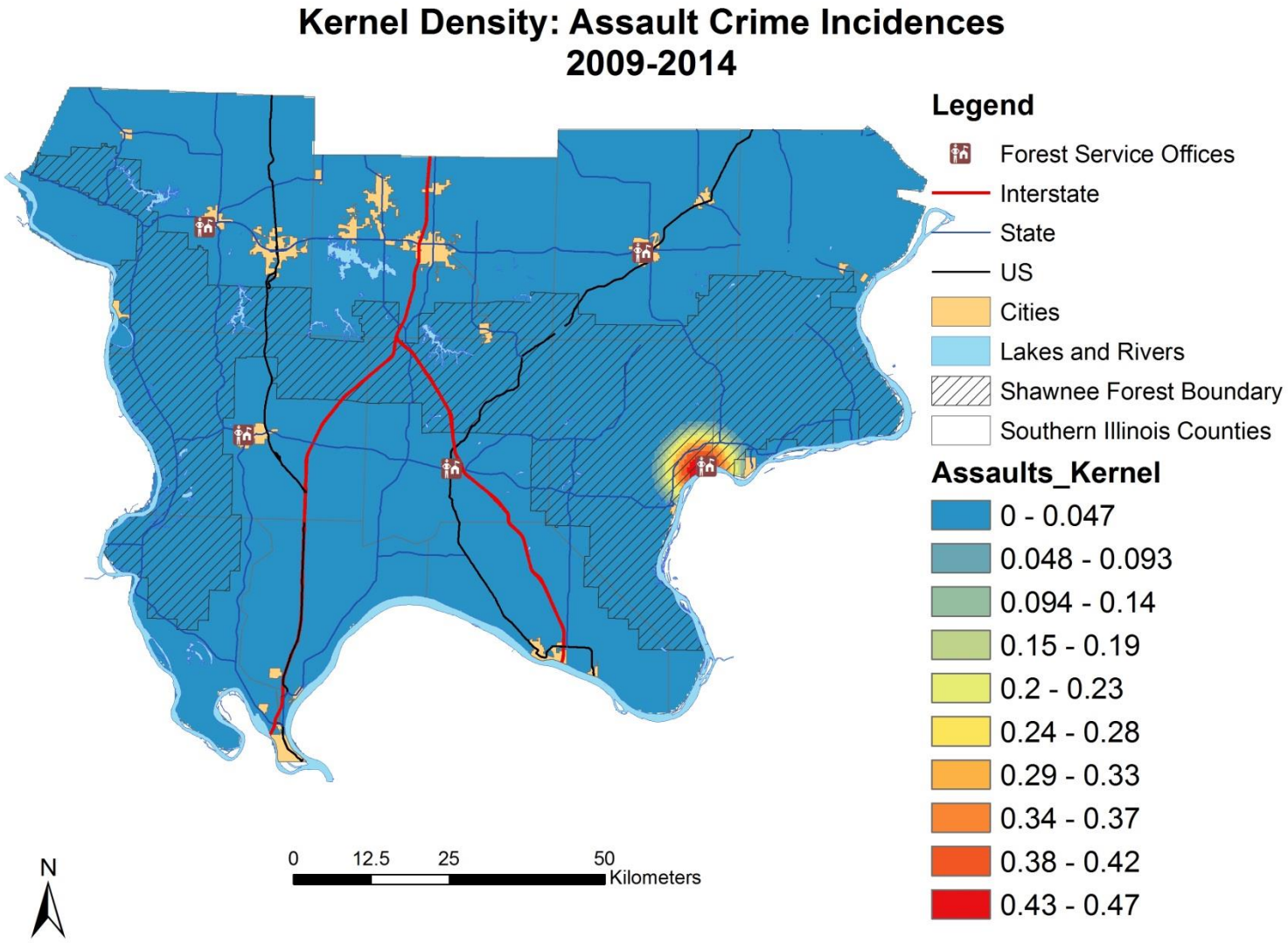

Figure 17: Kernel Density: Assaults Crimes Enlarged

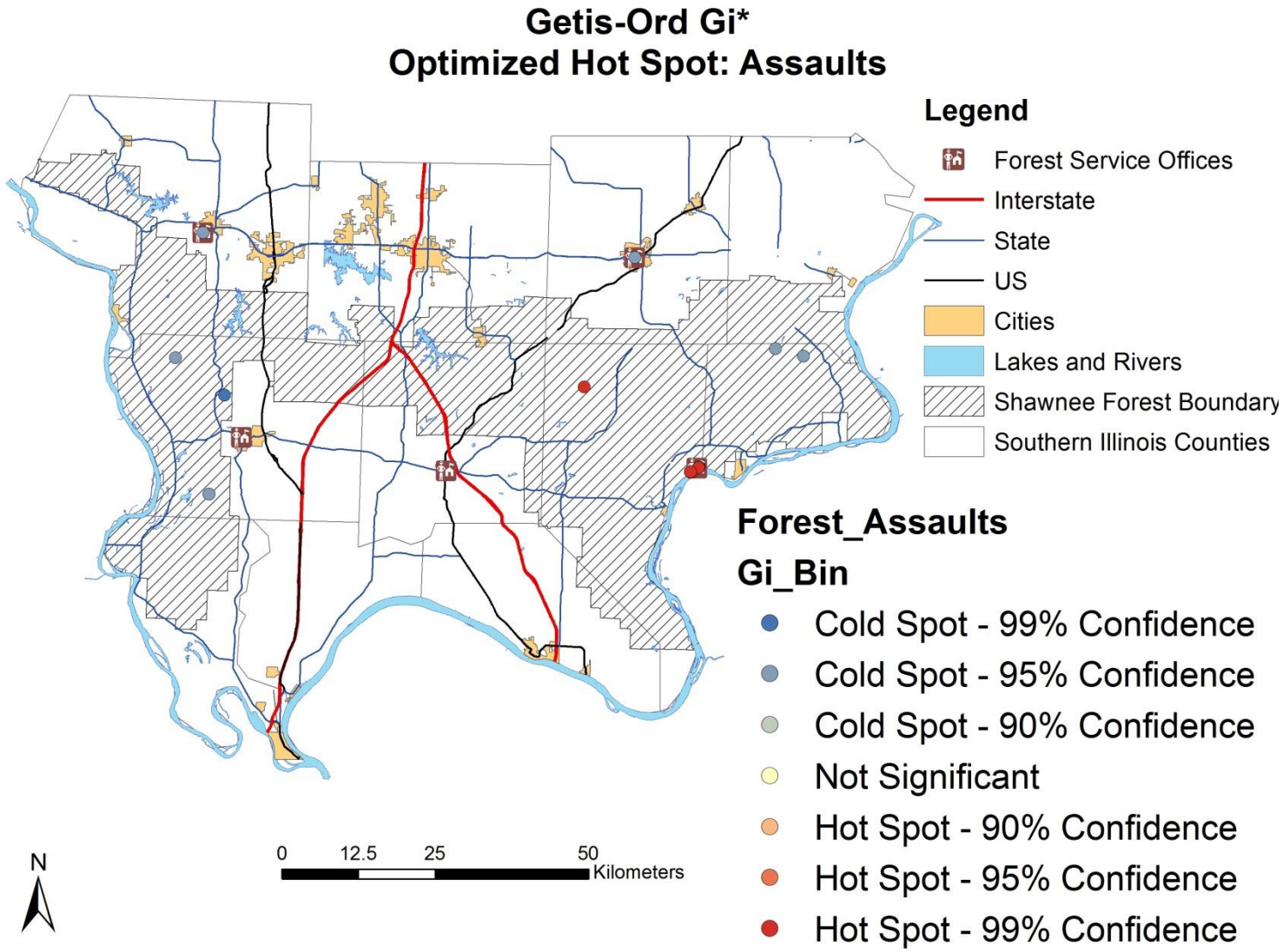

Figure 18: Getis-Ord Gi*: Assaults Enlarged

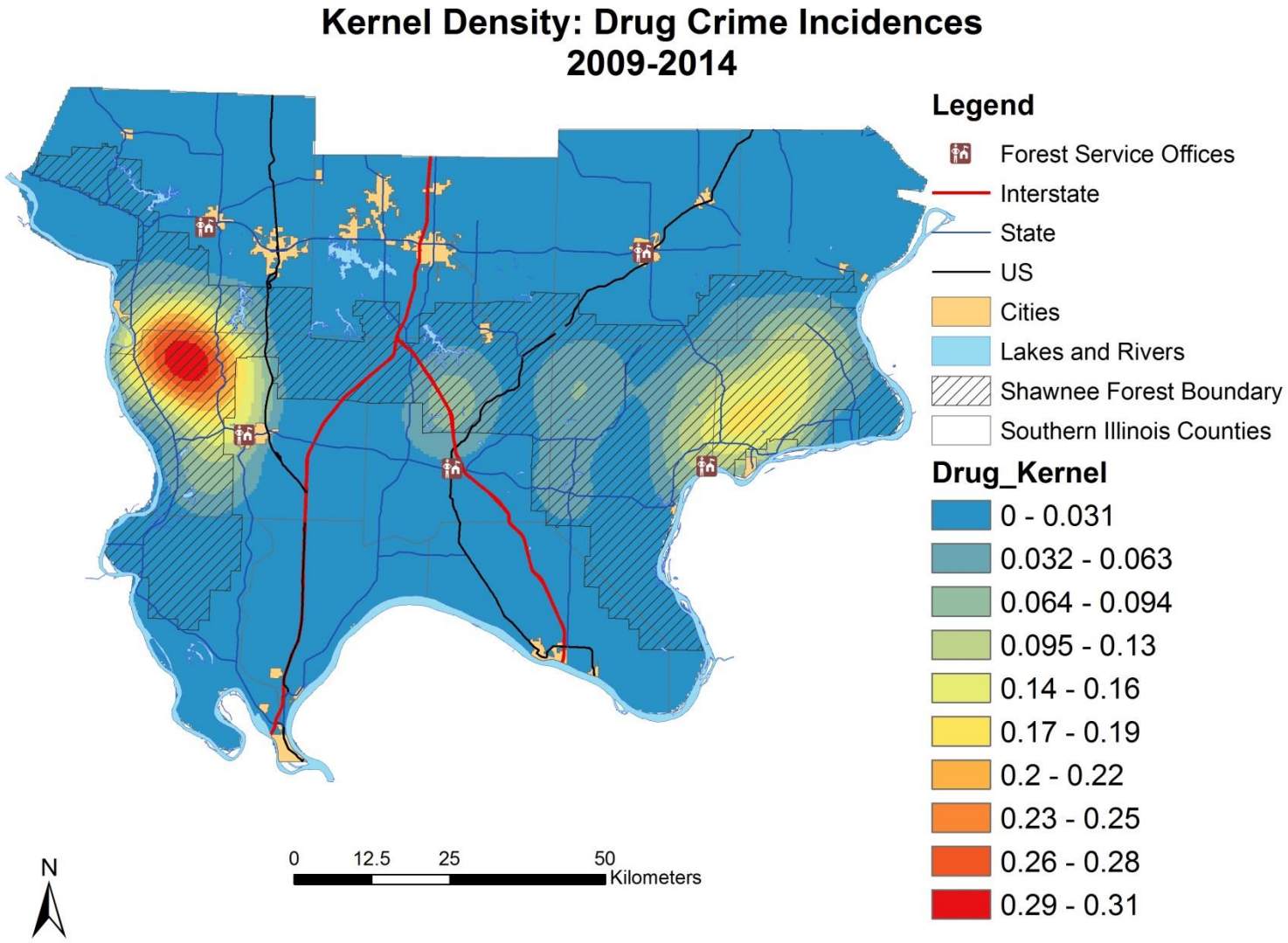

Figure 19: Kernel Density: Drug Crimes Enlarged

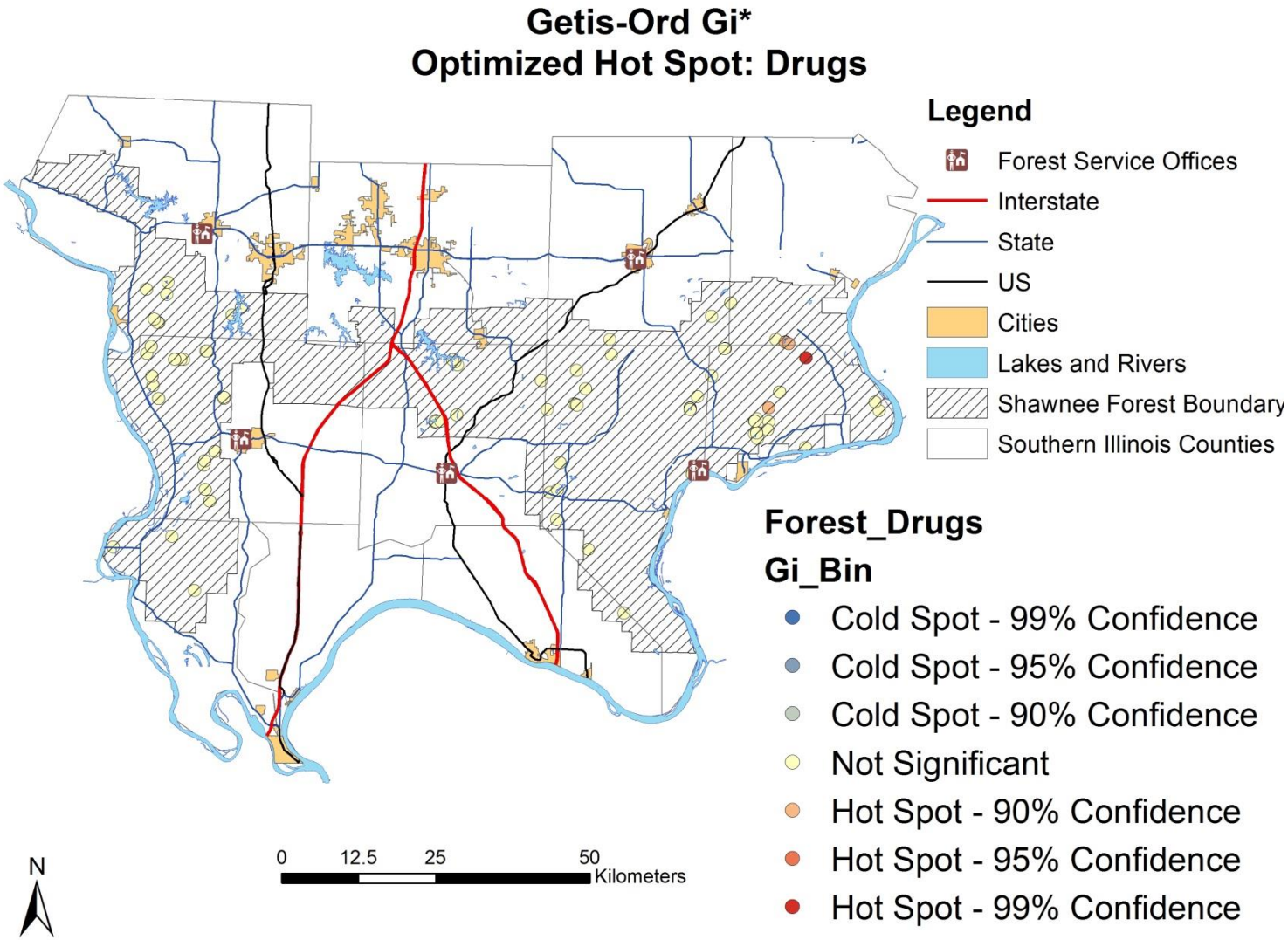

Figure 20: Getis-Ord Gi*: Drug Enlarged

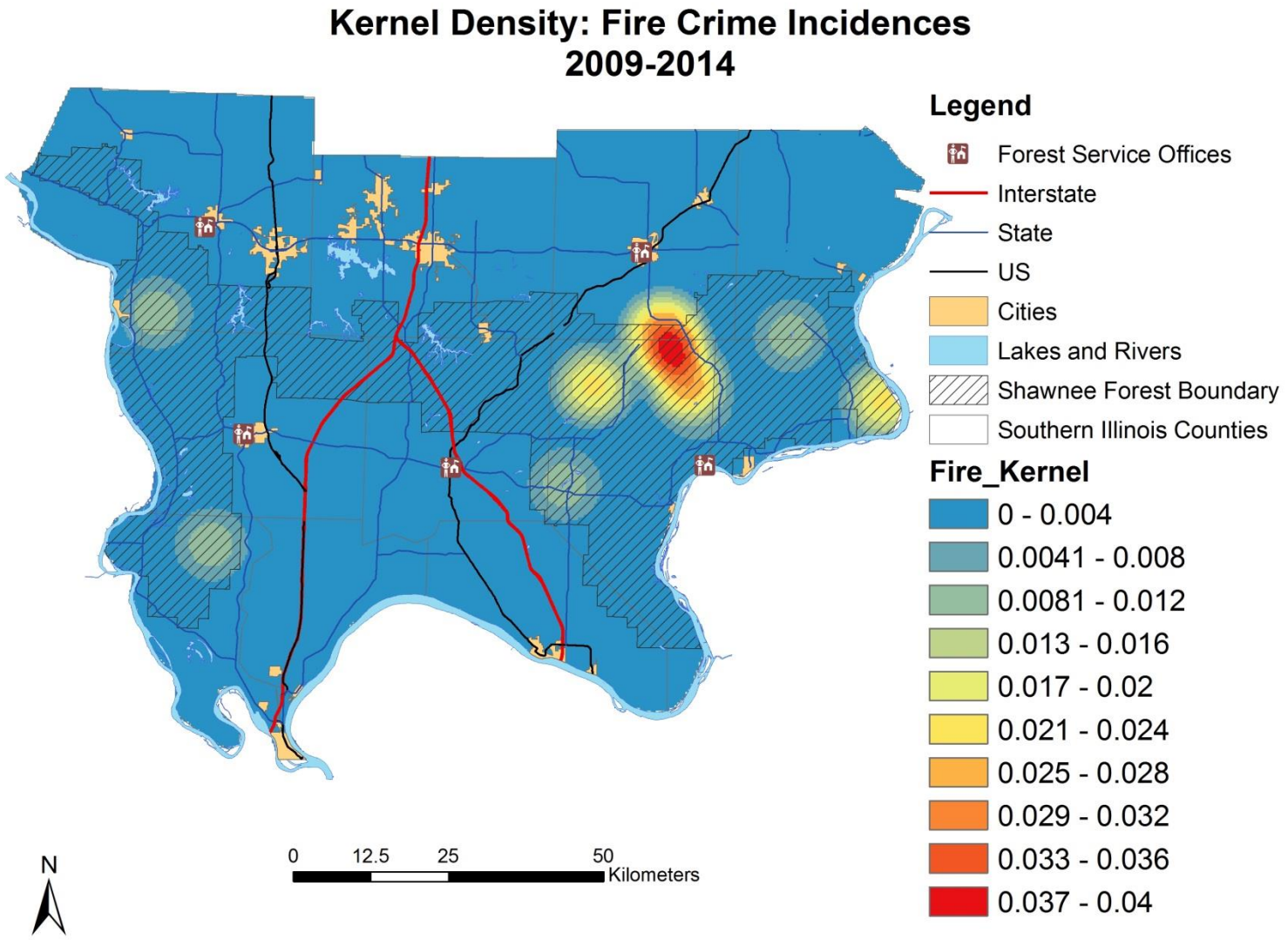

Figure 21: Kernel Density: Fire Crimes Enlarged

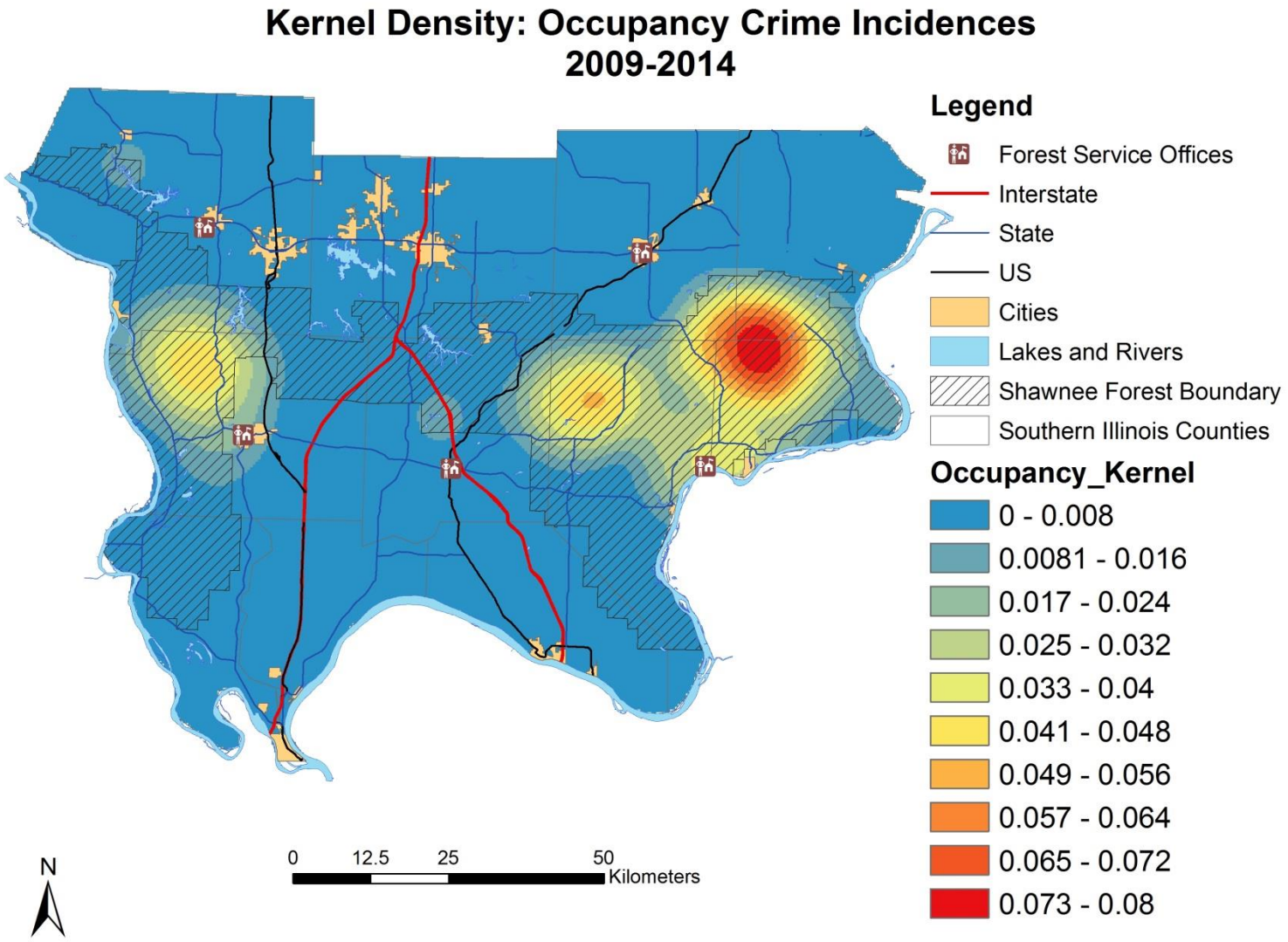

Figure 22: Kernel Density: Occupancy Crimes Enlarged

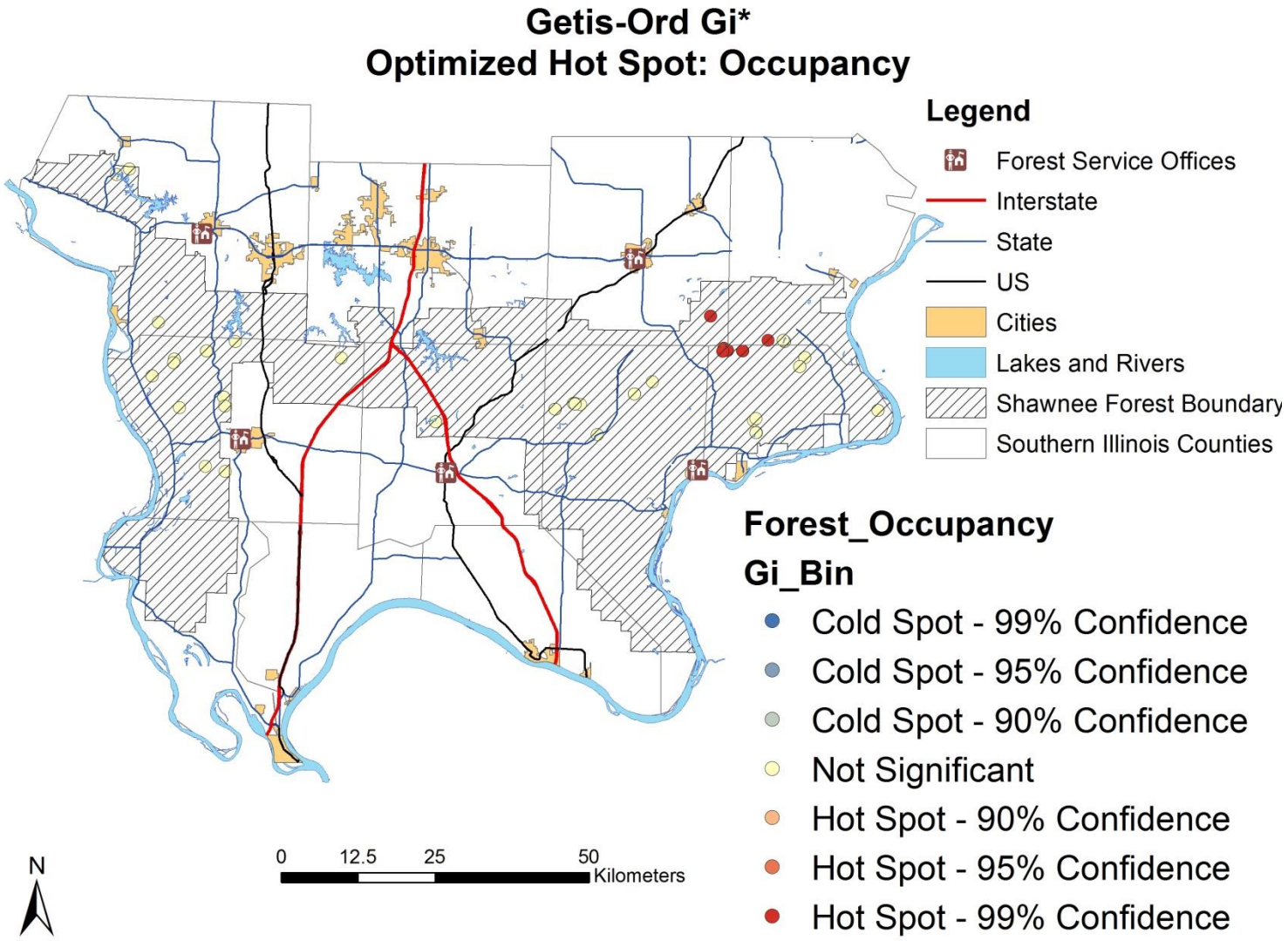

Figure 23: Getis-Ord Gi*: Occupancy Enlarged

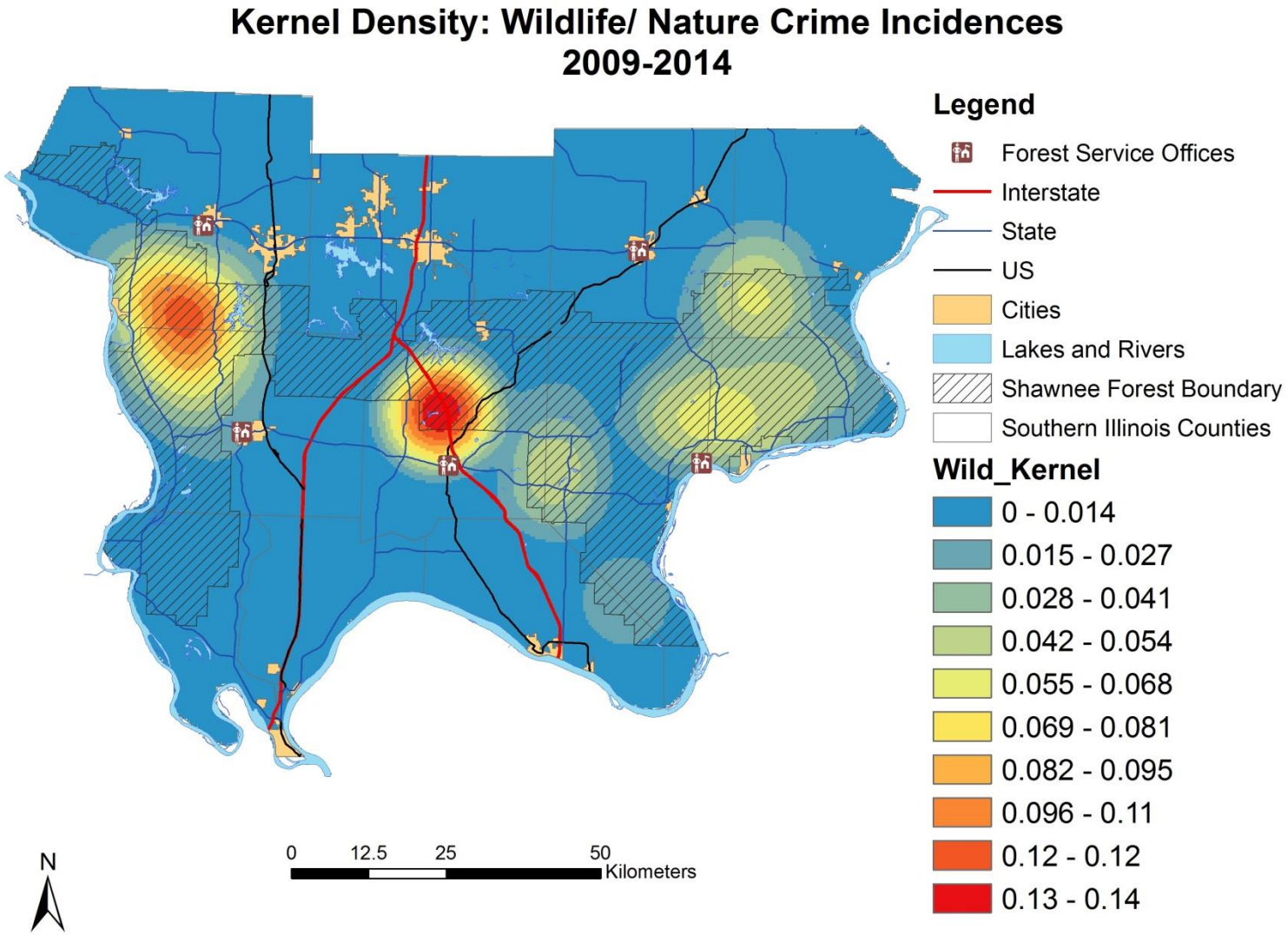

Figure 24: Kernel Density: Wild and Nature Crimes Enlarged

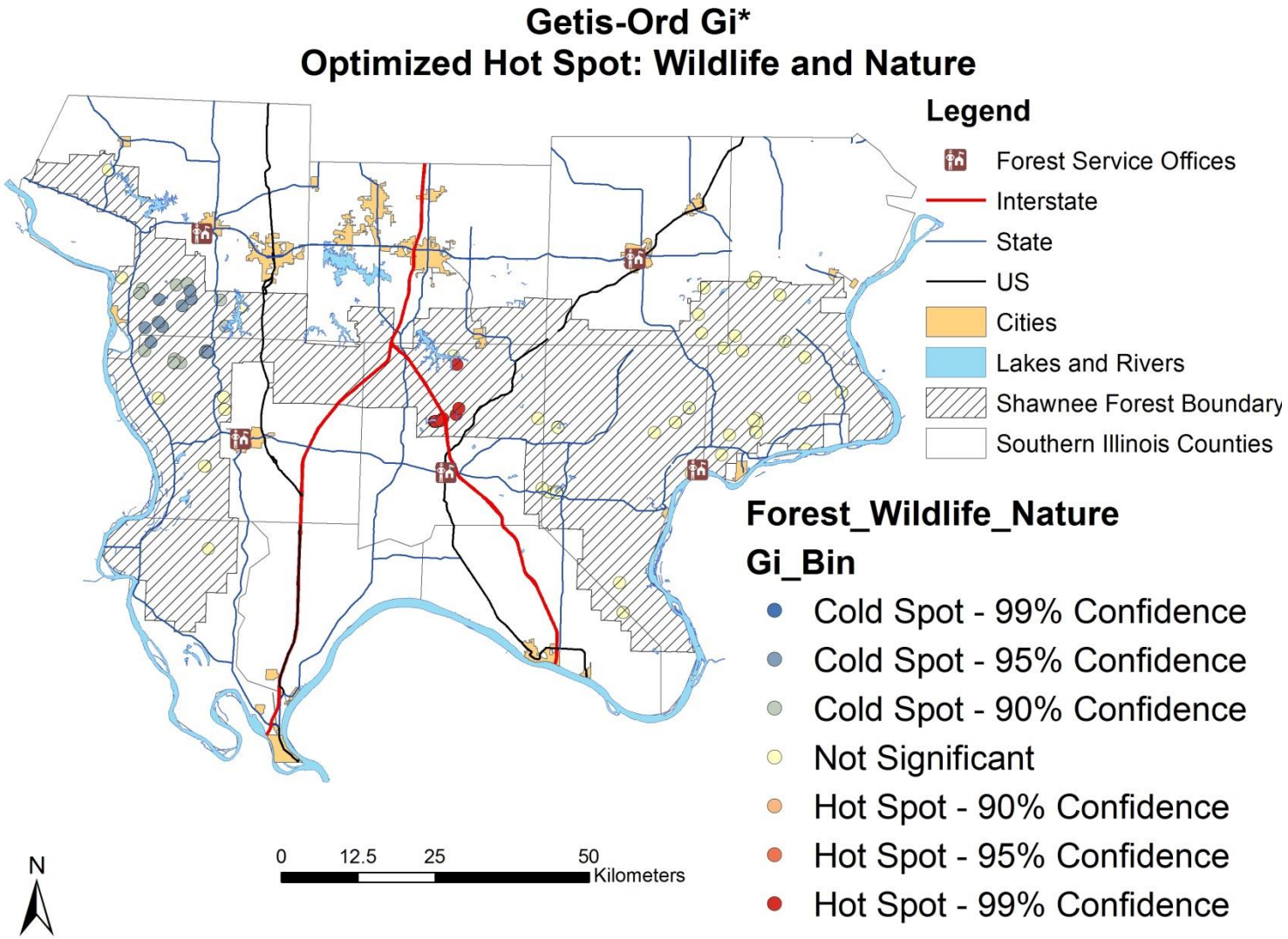

Figure 25: Getis-Ord Gi*: Wild and Nature Enlarged

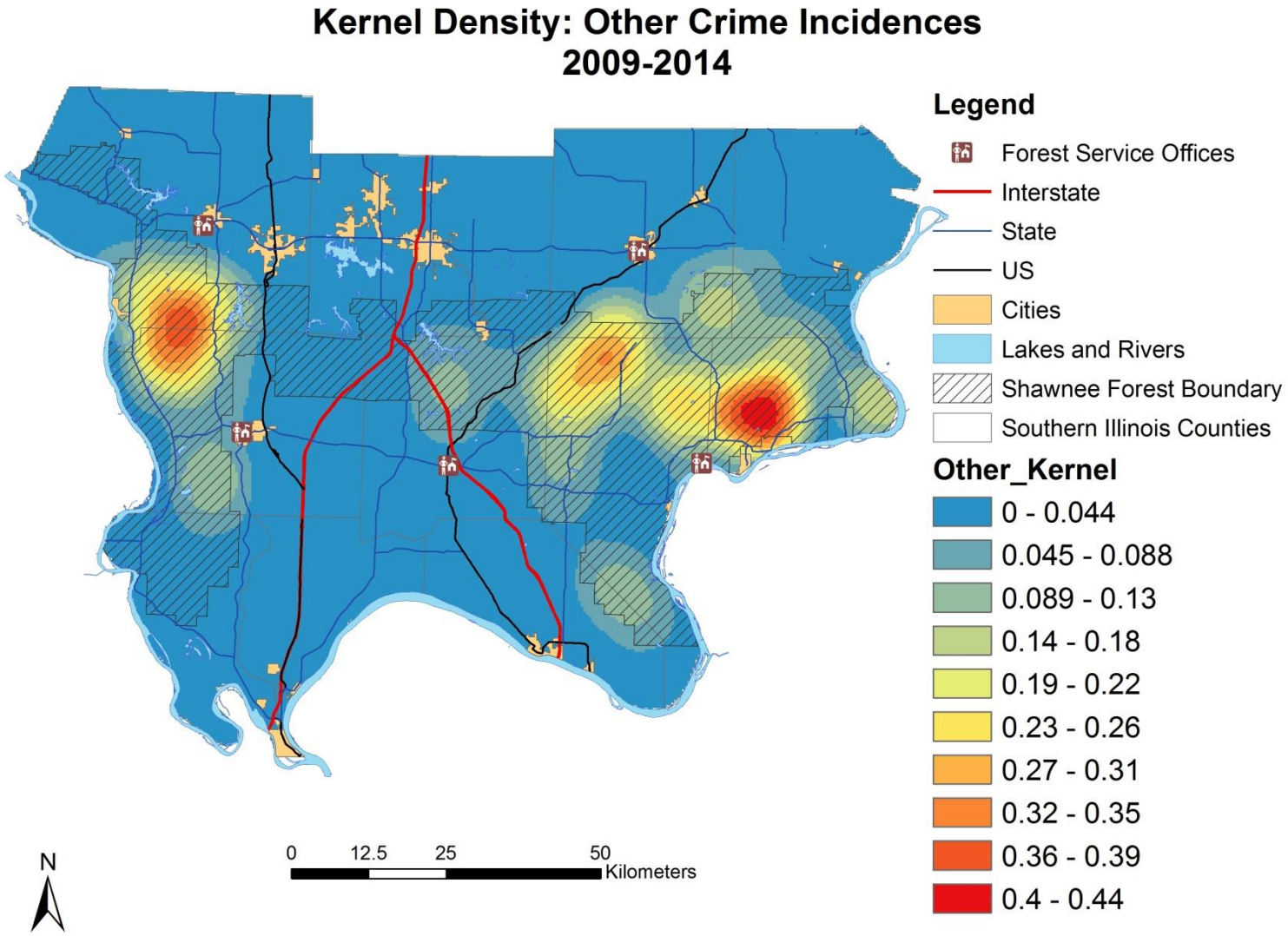

Figure 26: Kernel Density: Other Crimes Enlarged

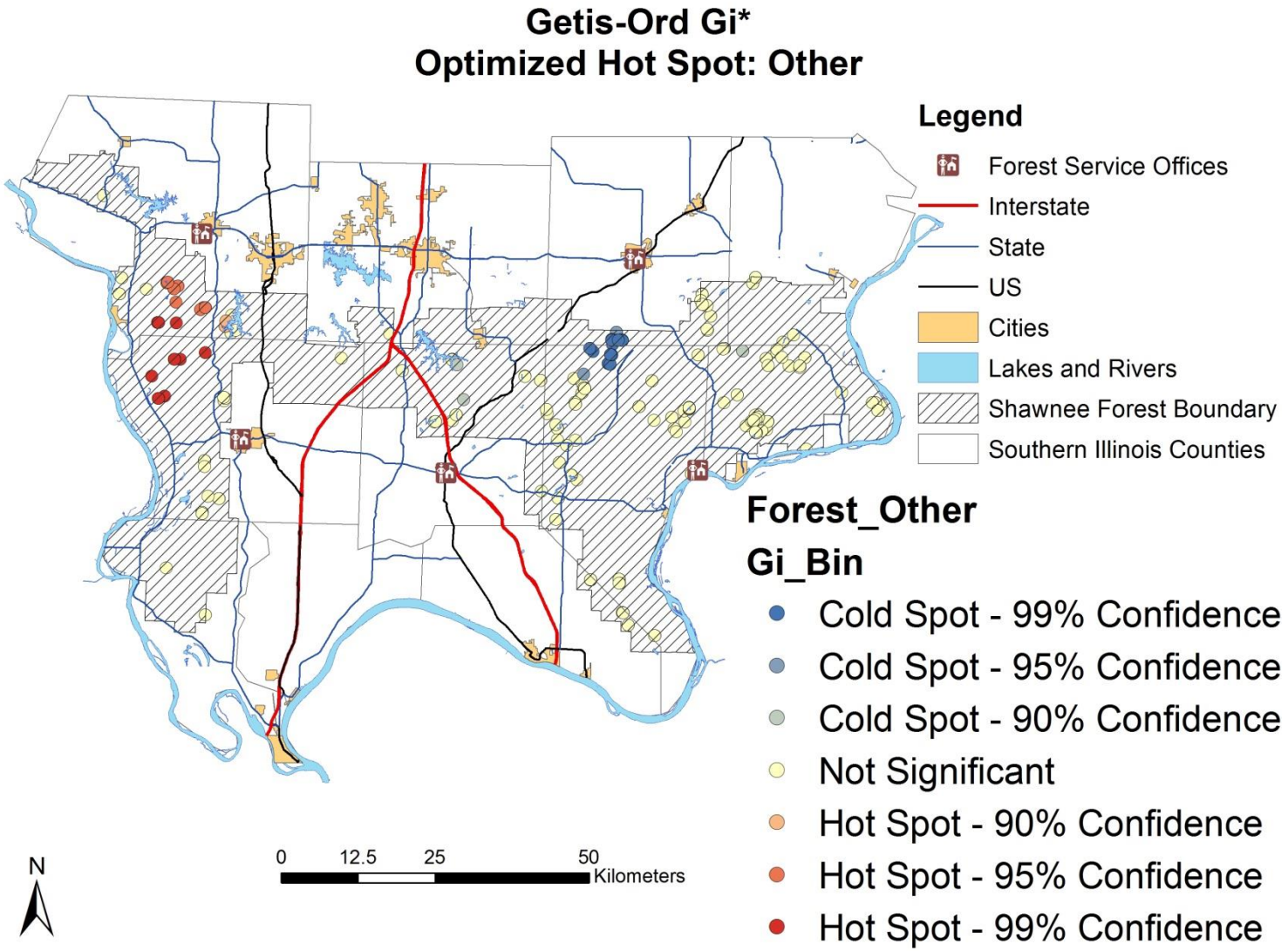

Figure 27: Getis-Ord Gi*: Other Enlarged

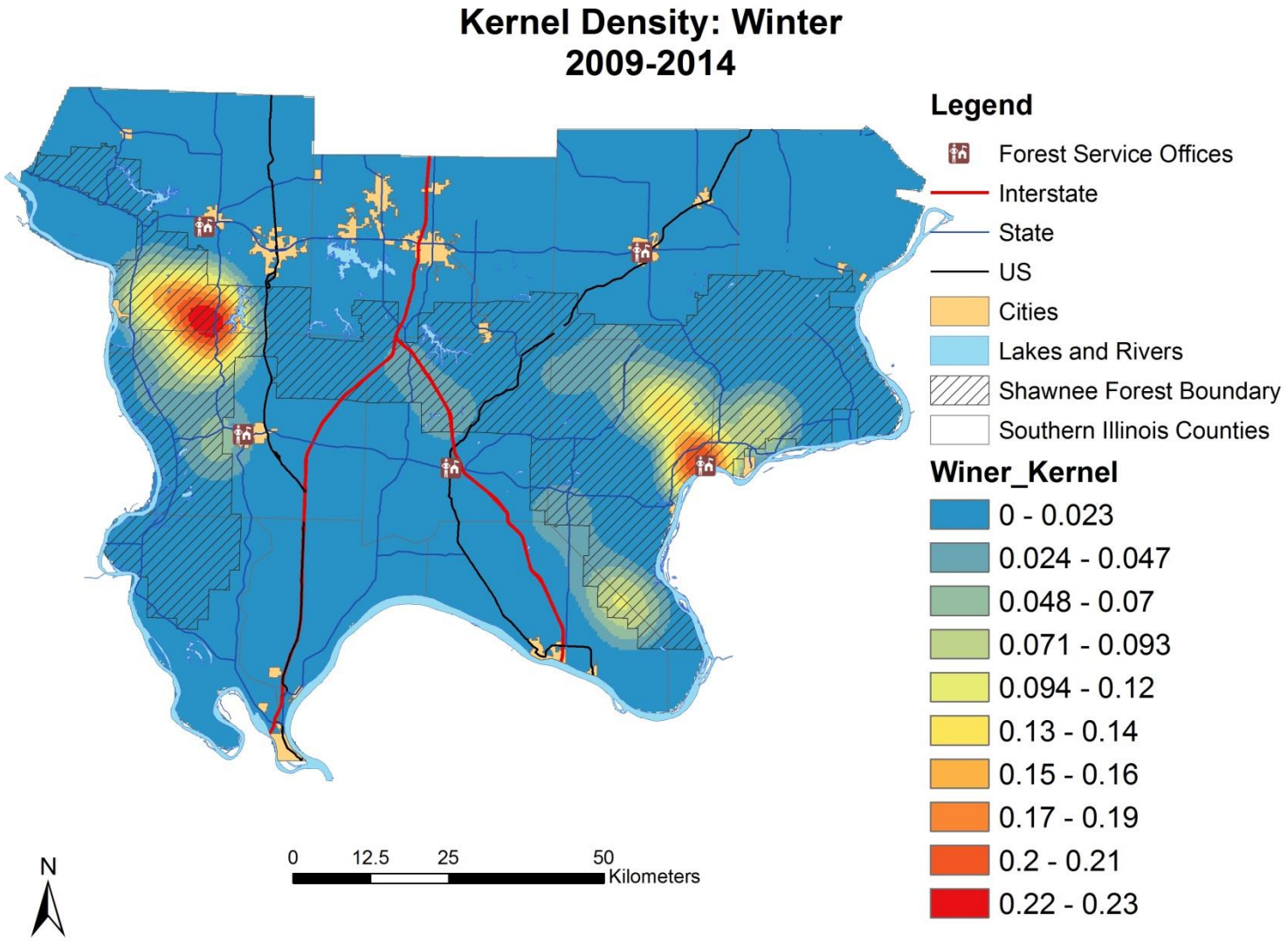

Figure 28: Kernel Density: Winter Enlarged

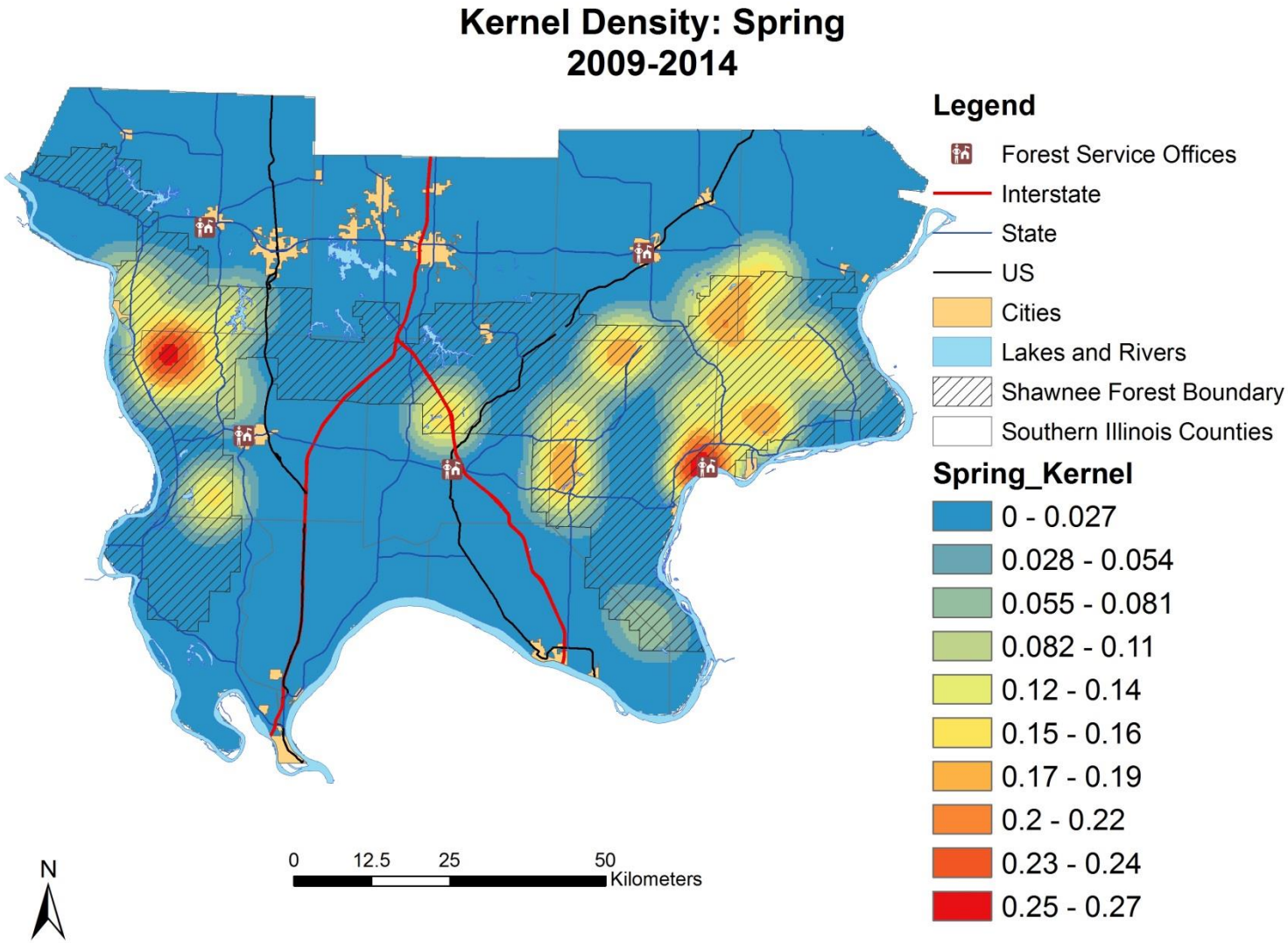

Figure 29: Kernel Density: Spring Enlarged

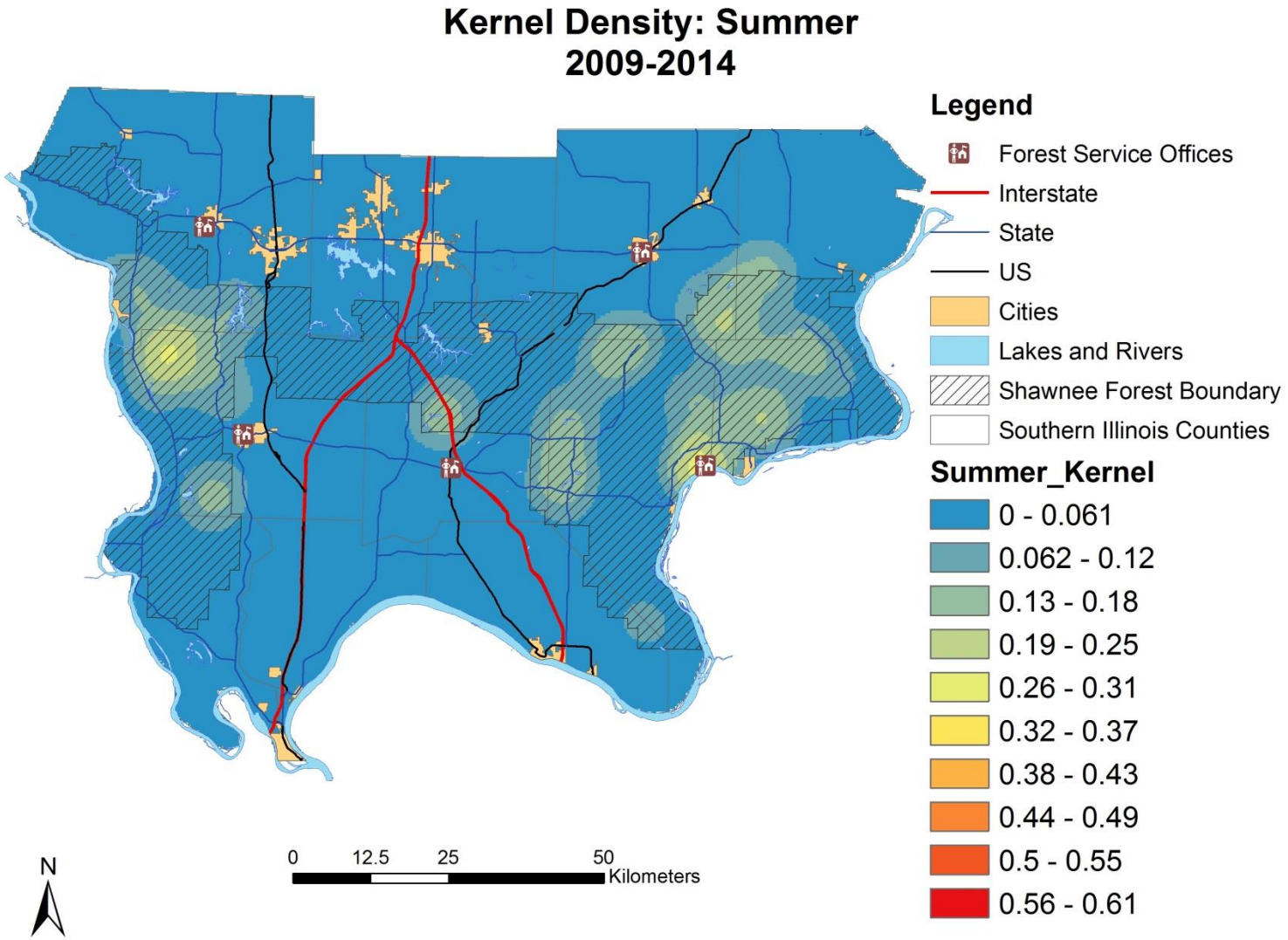

Figure 30: Kernel Density: Summer Enlarged

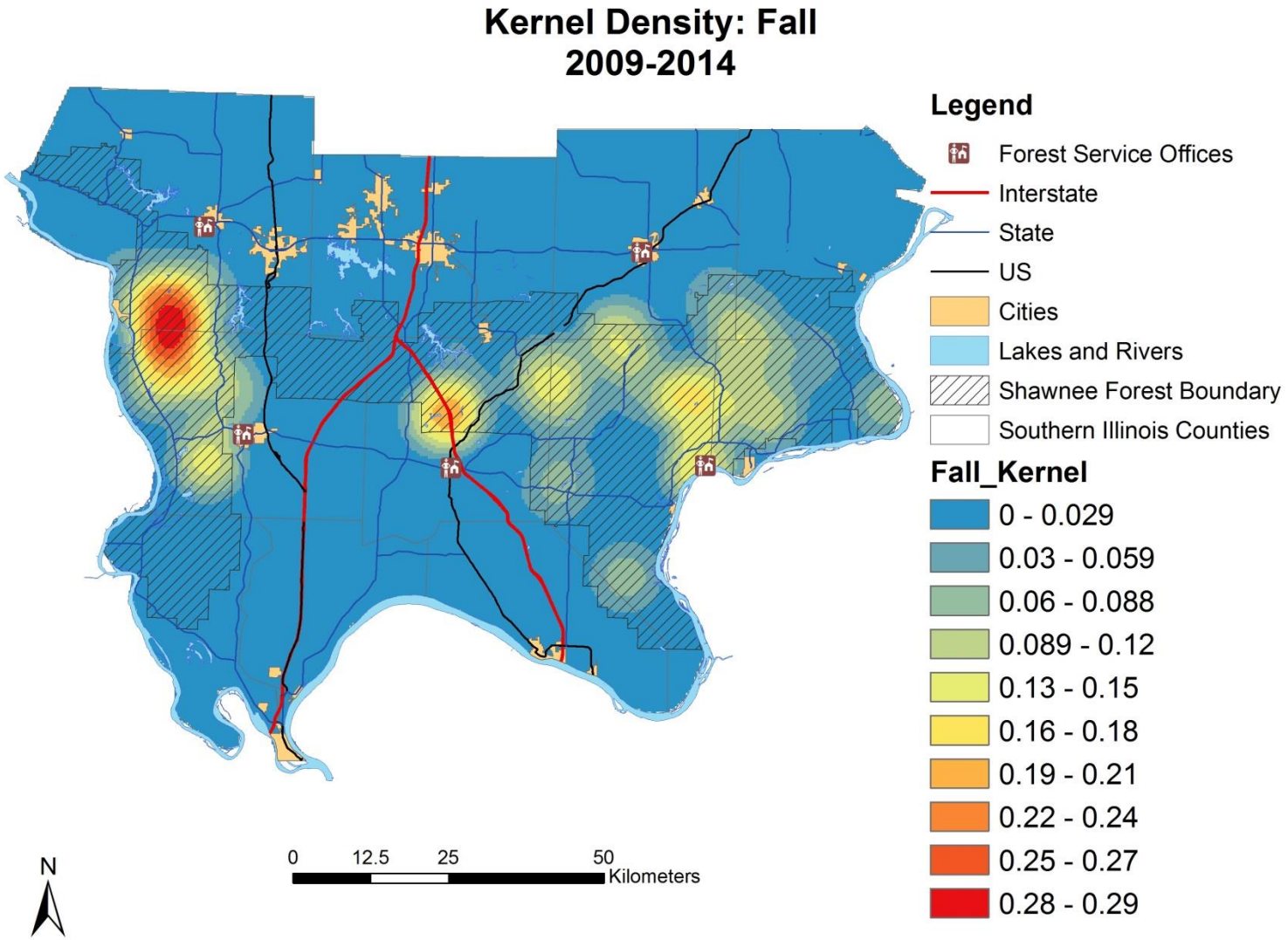

Figure 31: Kernel Density: Fall Enlarged

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Major Professor: Dr. Ruopu Li