Assessing Noise Pollution in Monmouth County New Jersey

INTRODUCTION

Noise pollution is a form of environmental degradation that is largely less talked about than the many other forms of pollution can take. Noise pollution can, however, have equally dangerous effects on human health. Exposure to prolonged or excessive noise has been shown to cause a range of health problems including disrupted sleep, stress, hearing loss, fatigue, and decrease in performance at school or work. As a Monmouth County native the goal of this project was to conduct a noise pollution impact analysis on human populations of Monmouth County, New Jersey.

“Sound maps” were created with the help of various GIS spatial and 3D analyst tools used to locate the areas of the county experiencing the highest levels of noise pollution. Various producers of loud noise including train stations, fire stations, air ports, and major roads were considered as well as available land data of variables that influence the dissipation of sound over land surfaces. These maps were then used to consider an environmental question of whether or not there was a correlation between areas experiencing high levels of noise pollution and instances of low-income populations.

KEY FACTORS

A sound vulnerability index was created through the consideration of three key factors: source locations, land cover, and elevation. Airports, fire stations and train stations were included in the analysis because these point source locations output sound levels above 85 decibels which is the point at which sound can damage hearing. Major roads of the area were also considered since vehicular traffic contributes a fair amount to ambient sound levels. High volume roads like highways can produce up to 80 decibels which hovers close to the point of hearing damage. Elevation was included because it influences how much sound reaches any certain point on the Earth’s surface. For example point locations of noise output at higher elevations are likely to affect greater surface area than noise produced at sea level because of increased dissemination of sound. Similarly, noise of source locations that lie at or below sea level are less likely to reach areas of high elevation. Finally, land cover was considered because surface cover and permeability affect the spread of sound. Natural surfaces like forests, grass and shrubs experience greater sound absorption than paved surfaces. Additionally, sound is less scattered in areas with decreased land cover like areas of water or barren land.

SOUND VULNERABILITY INDEXES

The original intention of this project was to utilize privately developed sound mapping tools that could account for additional factors like specific decibel levels, frequency, air temperature, humidity and wind speed. I was unable to do this due to experiencing many error messages, and not being advanced enough in Python to adjust the developer’s script to the needs of this project and my data. However, my methodology proved to be a useful work around. Although these sound maps are not the most accurate, they do consider the most important inputs of noise pollution. Both Fuzzy Overlay and Raster Calculator provide good estimates as to which areas of Monmouth County experience the highest levels of noise pollution.

To address my second research question there does not seem to be a correlation between areas of experiencing high levels of noise pollution and occurrences of low-income areas. Any household with a median annual income below $68,000 in New Jersey is considered low-income according to the US Department of Housing and Urban Development. Census data was used to display low-income block groups in Monmouth County according to this figure. Noise pollution seems to equally effect all households regardless of income. This is probably due to the fact that many areas in Monmouth County are highly developed, especially along the coast line which is consistently valued as the most noisy in both Sound Vulnerability Indexes.

DISCUSSION & CONCLUSION

After my data collection it was necessary to clean it by extracting only the area of Monmouth county from the point, polygon and raster data required for the analysis. Data was converted into the same projections and coordinate systems to ensure the smooth running of GIS tools. Euclidean Distance was run on Monmouth County’s train stations, fire stations, major roads, and the air point to represent the estimated reach of noise produced at those locations. The fuzzy membership tool was then run on the Euclidean distance outputs as well as raster data from land cover and the digital elevation model. This tool was useful since the classes of phenomena did not have sharply defined boundaries. Fuzzy membership then reclassified the data to a zero to one scale. Because this is a sound vulnerability assessment, zero was assigned to values that did not fall within the specified set of noise pollution. Areas of high noise pollution were assigned a value of one, those areas experiencing the least amount of noise pollution were assigned values closer to zero. This step was essential because multiple criteria was needed to create the sound map. After Fuzzy membership, the fuzzy overlay tool was used. Fuzzy overlay allowed for an analysis of data that belonged to multiple sets in a multicriteria overlay analysis. Raster calculator was also run using the fuzzy membership outputs as a means of comparison. The zero to one values of the fuzzy membership were added up to categorize areas of higher and lower noise pollution where higher values again indicate higher levels of noise pollution and lower values indicate lower levels.