The Dispersal of Artificial Night Lighting Around Sewanee Campus

Introduction:

This study will involve using a light meter to measure the levels of light dispersal that surround various sources of human produced night lighting and GIS mapping these sources to form a light map of an area of the Sewanee campus. Street lamps, residential houses, and larger buildings will be measured to compare the levels of light dispersal. Photopollution is an ever growing problem as areas become more and more developed. Ecological light pollution is defined as chronic glare, increasing light sources and temporary erratic changes in lighting. Migrating birds can become disoriented by areas lit by bright night lighting making them vulnerable to predators and collisions with other birds. Mercury vapor lights, a common outdoor type of lighting, can impede the detection of sonar screeches of bats by moths, preventing them from avoiding predation (Longcore and Rich 2004). Artificial night lighting can have other more indirect effects on organism behavior than simply predator-prey relationships. Female Physalaemus pustulosus frogs are less selective of mates in lighted areas, which could have possible effects on genetic diversity for the future of the species (Navara and Nelson 2007). These adverse effects are worrisome and may be prescient on the Sewanee domain. Therefore, we propose the formulation of a light map to illustrate the extent of light dispersal on an area of the domain.

Hypothesis:
The dispersal of light throughout the area of Sewanee campus is heterogeneous, that is, interspersed with dark and light areas, rather than being homogeneous and a beacon of solid lighted area.

Methods:
Various residential houses, buildings, and street lamps in the area around Tennessee Avenue, Sewanee, Tennessee will be measured systematically using a light meter. This will measure the levels of dispersal in the area surrounding the light source. This data will allow us to generalize the distance from a light source that a street lamp, building, or house may illuminate. Those generalized distances can be extrapolated across the scope of our field of study onto an existing map of campus in order to create a map showing areas of campus that are illuminated as well as the spaces that are not illuminated. Through use of GIS, we can specify points on campus, which emit light, and create a buffered area around those points representative of the zone of illumination. The overall map will then be analyzed to determine whether or not artificial light is evenly dispersed throughout the area or if it is heterogeneously dispersed, as our hypothesis predicts.

Statistical Analysis:

The light meter will be used to detect the continuously decreasing gradient of light as it disperses into the area around the source. When light from the original source can longer be detected by the light meter, the area will be considered a dark area and will appear on the map as such. The light meter readings will allow the GIS program to formulate a map that factors in the collected data and apply it to each house, streetlamp, and residential building in the area. It will be assumed that each street lamp, house, and building have the same light data as the street lamps, houses, and buildings tested with the light meter. This map will allow us to see the percentage of light and dark areas in our field of study.

Expected Results:

The resulting light map will depict an area of artificial light that is dispersed according to areas of high density residential areas. However, distributed between the areas of light will be areas where no artificial light reaches at all. These areas, whether too swampy or steep to develop, may prove to be essential for certain nocturnal organisms that are greatly influenced by light patterns. The future study of the areas of heterogeneous light dispersal may be valuable to understanding light pollution. Many
aquatic insects depend on polarized light given off by bodies of water navigate. However, polarized light is also given off by oil spills, plastic tarps and windows, which can prevent correct navigation and fragment habitats (Horvath, Kriska, Malik, and Robertson 2009). Studies in the effects of light dispersal are still relatively young (Harder 2004), as demonstrated by the phenomenon of the northern mockingbird. The mockingbird usually only sings at night before mating, however mockingbirds are now singing after mating in areas of artificial light. The implications of this occurrence are as yet unknown (Navara and Nelson 2007). The fact that 6% of the US’s 4.054 million megawatt hours are used for outdoor lighting and an estimated 30% of that is wasted as light pollution is proof enough that light pollution is a widespread enough problem to verify further research (Gallaway, Olsen, and Mitchell 2009).
Reference List


