CONOR CASEY

Is it Possible to Create a Mathematical Model to Predict Photopollution Based on Population Density in Munster?

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Project Proposal

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The purpose of this project is to determine if there is a correlation between population density and photopollution, if so can I create a mathematical model to predict it, and to extrapolate what the data collected means. Photopollution is defined as the presence of anthropogenic visible light in the night environment.

It is apparent that densely populated areas tend to have far more photopollution than sparsely populated ones. Just look at an aerial photograph of a city taken during the night compared to a more rural area. In this modern world, photopollution data is provided by satellites so as a consequence the idea for this project came to me when I was pondering whether it would be possible to determine the severity of photopollution without the need of satellites.

To investigate this problem, I would measure the photopollution produced in an area. I would do this in accordance with the method cited by the National Lighting Product Information Program in one of their articles. This method is often used by professional astronomers, it involves using an instrument called a photoelectric photometer in combination with a telescope. They measure the dark portion of the sky with said astronomical instruments. Typically such measurements are made at the zenith.

I would use this experimental method in my experiment to measure the photopollution at various locations. The photometers are easily accessible and can be bought for around £17 on Amazon. I already have a telescope removing the need to purchase one. This photometer has a high accuracy with an error rate of +- 4%. At worst to include 15 different sites in the experiment, it should take approximately one month, which is sufficient time to complete this project before the BTYSTE in January. I plan to include 15 sites in my experiment. With luck, I could possibly include 20 to 25 different sites. The population density data necessary for this experiment is provided by the results from the Census in the year 2016 which can be accessed from the Central Statistics Office website. In order to create a mathematical model and find a relationship between these two variables, I would use a scatter plot and a trend line in Excel, however, I am exploring other options at this present time. I could possibly use another program called GeneticSharp. To determine what these values mean I would use the photopollution grading data provided by Globe At Night, which is a website where amateur astronomers grade the quality of photopollution in their area, in order to extrapolate what the data collected means in relation to the severity of photopollution. However, again I am exploring other options for grading and understanding the data. A Python Program will be developed with the mathematical model developed built in to show what a potential use for the model could be.

Preliminary results show that there is a correlation between the two variables however it was over a relatively low sample size and as such more data is required.