Light Pollution at the College of St. Benedict and St. John's University

ENVR 395 Fall 2016 By : Pearce Jensen Advisors: Derek Larson & Troy Knight

Introduction

Light pollution, defined simply as the alteration of nights natural lighting caused by human sources of light, has been present since the creation of artificial light. Although this pollution is still being studied it has been found to have adverse effects on humans, animals, and plants. Unfortunately for the worlds ecosystems and their inhabitants little has been done to stop the spread of light pollution and thus reduce its impacts. Though some government regulations have been put in place and some NGO's have formed to combat this issue worldwide recognition is still needed. This study addresses the issue of light pollution and its presence at St. John's Univeristy and the College of St. Benedict. By analyzing various scholarly articles a comprehensive summary of the issue of light pollution is presented along with a specific study conducted at St. John's University and the College of St. Benedict which looks at the amounts of light pollution present at both campuses. From this information it is clear that the implementation of fully shielded light fixtures and "warm" LED lighting will help reduce the impacts of light pollution on both campuses.

The Night Sky With and Without Artificial Light

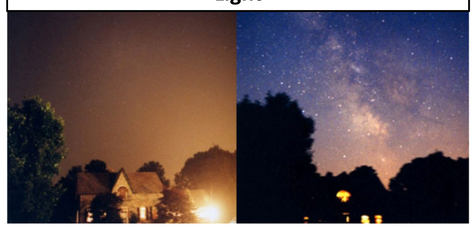

Figure 1: The Milky Way and countless stars are visible after an earth quake caused a blackout in Los Angles, CA

The Presence of Solutions and Barriers at Each Campus

	College of St. Benedict	St. John's University
Fully Shielded Light Fixtures	Needed	Present
"Warm" LED Lighting	Needed	Needed
Safety Concern	Present	Present
Overall Cost	Allocated Funds	Allocated Funds

Table 1: Description of the various solutions and barriers present on each campus

Methods

Data that focused around the source, impacts, and solutions of light pollution were collected through the review of various scholarly sources which ranged from the impacts of light pollution on ray-finned fish, such as salmon and tuna, to current mitigation strategies taking place for light pollution in the southwestern United States. To determine the presence of light pollution at the College of St. Benedict and St. John's University data was collected as follows:

- Transects, which generally ran north to south or east to west, were determined across each of the college campuses
- Transects were selected based on the availability to take data reading across campus with the least amount of buildings in the way
- Data was collected every 20 meters on these transects using a Unihedron Sky Quality Meter and a "Loss of the night" application
- The Unihedron Sky Quality Meter collected reading of "magnitudes per squared arc second" while the "Loss of the night" application recorded GPS site locations and the limiting magnitude of a location based off of the visibility of certain stars
- Light pollution readings were then paired with the GPS site locations and Geographic Information Systems was used to create a map of light pollution distribution across both campuses.

Light Distribution Across St. John's University and the College of St. Benedict

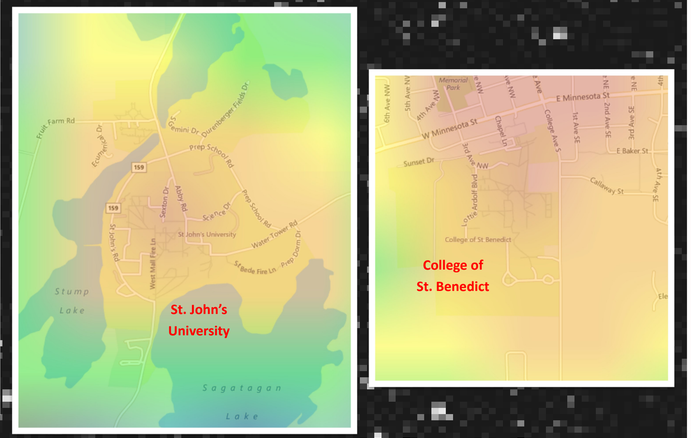

Figure 2: Moderate levels of light pollution can be seen as yellow around St. John's while slightly higher levels or light red can be seen at St. Ben's

The Various Forms of Light Pollution

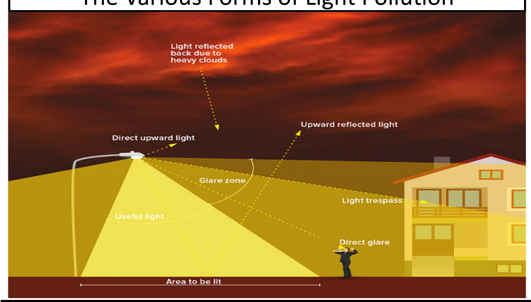

Figure 4: Diagram depicting how the different forms of light pollution interact

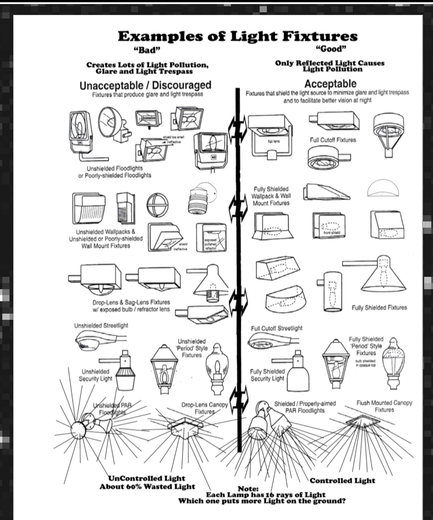

Figure 3: Benefits of fully shielded lighting fixtures

Discussion

Main Source of Pollution

- Outdoor lighting that is "unshielded", meaning that light is not directed in a certain direction
- Specifically High pressure Sodium and LED lighting are most commonly used outdoors

Main Impacts of Pollution

- Linked to the reduction in melatonin levels which is responsible for the control of circadian rhythms
- Reduced melatonin in humans can lead to sleep disorders, psychological disorders, and some evidence shows a link to an increased risk of breast, prostate, and colorectal cancer
- Decrease presence and distract terrestrial animals, especially nocturnal individuals
- Disorientation and disruption of nesting grounds of aquatic species
- Low efficiency of lighting as energy is being used to illuminate unnecessary areas
- White LED's emit nearly five times more blue light then High Pressure Sodium lights meaning they have a greater effect on reducing melatonin levels

Possible Solutions

- Government regulation controlling outdoor lighting fixture and the amount of lighting used in certain areas
- Fully shielded lighting fixtures that direct light only where it is needed
- "Warm" LED lighting that saves energy and only emits similar levels of blue light as High Pressure Sodium

Various Levels of Light Pollution Across Minnesota and Wisconsin

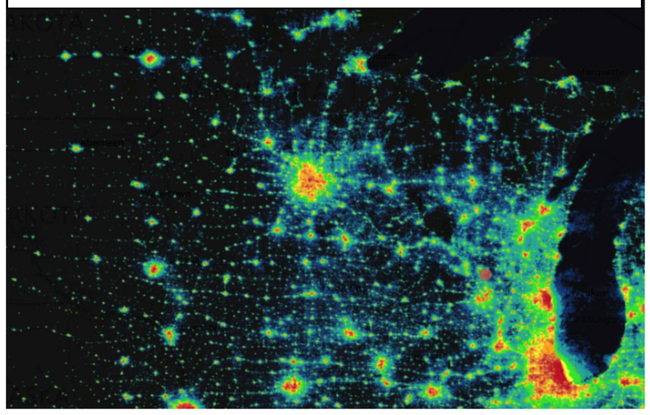

Figure 5: Distribution of light pollution with higher intensities being depicted in red and yellow

Conclusion

From this study it is clear that action needs to be taken to impede the spread of light pollution. At the College of St. Benedict and St. John's University, where light pollution is present in moderate levels, implementing fully shielded lighting fixtures, transitioning to "warm" LED lighting, and only using lighting when and where it is necessary should be the top priorities when new lighting is put in place.

Acknowledgements

I would like to thank the office of Experiential Learning and Community Engagement for providing funding for my Unihedron Sky Quality Meter.

References & Further Readings

"Light Pollution." International Dark-Sky Association. http://darksky.org/.

"Global Light Pollution Map." Earth Observation Group & NOAA National Geophysical Data Center.Lightpollutionmap.info.