THE BASIN AND RANGE DARK SKY COOPERATIVE

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MEMBERSPOTLIGHT

SHOW ME THE DATA: LIGHTING INVENTORY INNOVATIONS

BRYAN BOULANGER
Professor of Environmental Engineering,
Ohio Northern University

AN UNFAMILIAR EXPERIENCE

For the majority of us, what we see of the night sky from where we live is a partial reality. In fact, most of humanity is now living under a lesser version of the natural night sky without even realizing what has been lost. If you are reading this, you most likely already know this fact and have had your own realization about why and how you should become involved in night sky awareness and conservation efforts. My own realization happened in a remote location in far West Texas while camping and climbing with some friends near Guadalupe Mountains National Park.

Far from the nearest settlement we found a place to camp, grabbed only our sleeping bags, and prepared for a cold night camping in the open desert. As we settled into our sleeping bags for the night, I saw a beautiful, completely star filled sky that was entirely unfamiliar. The version of the night sky that had been most familiar to me throughout my life consisted of only a few planets and stars, some partly recognizable constellations, and light dome filled horizons.

At this time I had just started my career as a professor of civil and environmental engineering and despite prior years of training and previous work experience at the United States Environmental Protection Agency, I had never once been introduced to the concept of light pollution nor to the fact that my profession was largely responsible. I determined that if my chosen profession had helped to create the infrastructure that was contributing so much to light pollution, then maybe engineers could also help reverse this trend.

I wish I could say that my experience in the Guadalupe Mountains led me to immediately get involved in night sky conservation efforts, but the reality is that it took another seven years, a change of institutions, and a bit of soul searching before I was able to engage in night sky conservation in a meaningful way. The recognition that occurred to me in West Texas changed my trajectory for the better — even though it took some time.

Texas' Guadalupe Mountains National Park. Photo: A. Cohrs / National Park Service

STREAMLINING THE PROCESS

My entry into the complexity of night sky conservation efforts eventually came about in 2015 following a discussion with park officials at Yellowstone National Park. While I was in Yellowstone for other work-related reasons, I asked park officials about whether or not they had considered becoming an International Dark Sky Park. It turns out that they had considered doing so for quite some time, but were stuck on the lighting inventory portion of the application. Park officials were well aware of the challenges in conducting a lighting inventory that had proven difficult for other, smaller parks. Staff had attempted inventorying the exterior lighting in the Old Faithful geyser basin but had eventually given up. I left Yellowstone realizing that I was in a position to personally and professionally invest in helping them collect the required lighting data.

Since counting and characterizing lighting was a new challenge for me, I figured I could streamline the process as compared to earlier efforts. I also recognized that I could involve undergraduates from Ohio Northern University (where I now work) in a meaningful way. The students would get hands-on experience examining lighting with the goal of raising their own awareness of what good design looks like. For me, this was a win-win opportunity. When doing the initial research for the undertaking, though, the effort quickly went from a cool project meant to engage students to a far more complicated pursuit.

Over the next few months I researched data collection methods for completing lighting inventories and consulted with experts such as John Barentine from the International Dark Sky Association (IDA), the National Park Services Natural Sounds and Night Skies Division, and many others who had already completed inventories within other park units. and others who had already completed inventories within other park units. It became clear that a new approach was needed and after much learning and multiple field trials, I developed a data collection system that utilized a Geographic Information Systems (GIS) application called ArcGIS Collector. ArcGIS Collector is a mobile data collection app that makes capturing accurate data while out in the field both streamlined and approachable.

Over six weeks of nearly round the clock effort (spread out over a summer), a group of us used the data collection system to identify and characterize more than 5,000 exterior lighting fixtures spread out across Yellowstone's 2.2 million acres. This still remains one of the largest (and fastest) efforts to count exterior lighting fixtures at any park unit. While Yellowstone still has a way to go in completion of their International Dark Sky Park application, what we learned from this initial data collection trial has become invaluable in moving other partners forward with their night sky conservation goals.

Castle Geyser & Milky Way Yellowstone National Park. NPS photo by Neal Herbert

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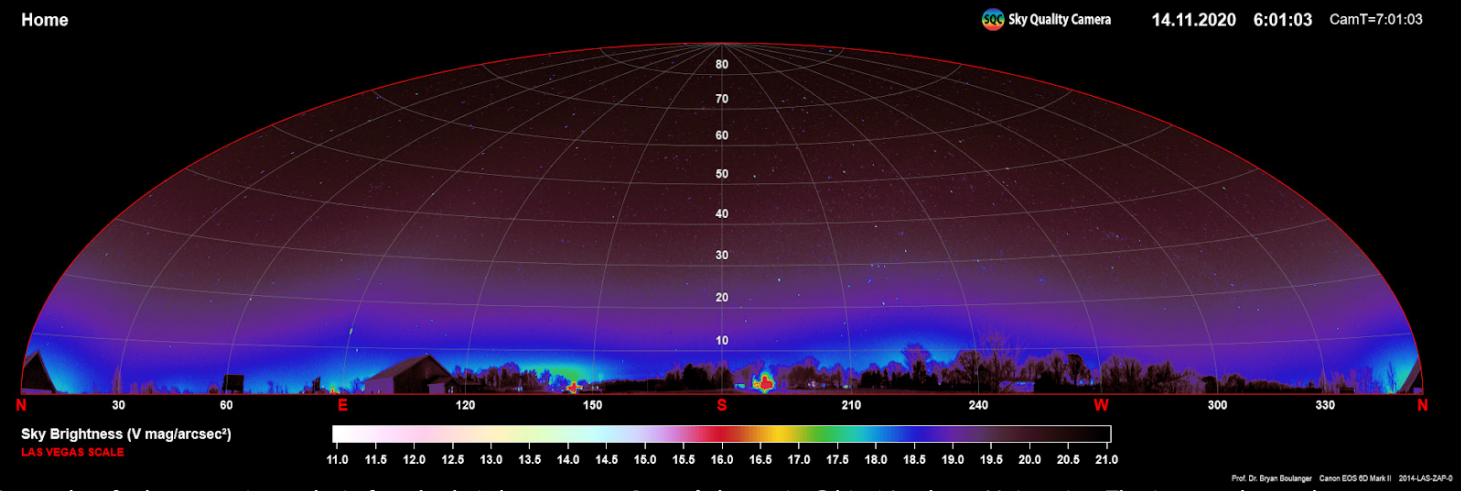
CONTINUED INNOVATION

In the years since the initial Yellowstone project, the tool I created has been shared with others and further adapted. I now utilize the tool to make lighting design recommendations on the go as I complete lighting inventories. While the first approach to completing a GIS-based inventory was meant to only locate and characterize lighting, the current version of the inventory tool now is used to estimate replacement and labor costs for proposed retrofit projects as well.

> *"We went from being able to identify, locate, and characterize 100 or so fixtures per day using multiple teams of people, to providing information on more than 300 fixtures per day with a team of only two people."*

We went from being able to identify, locate, and characterize 100 or so fixtures per day using multiple teams of people, to providing information on more than 300 fixtures per day with a team of only two people. We can also produce a complete report soon after the inventory is completed that supports a partner's efforts to not only submit a dark sky park application, but to improve their lighting with actionable data. If there is an interest in modeling energy use or the economics of replacement decisions, we can do that too. In addition to these valuable services, I've recently gained the ability to perform quantitative photometry of the night sky and existing lighting installations and I'm looking forward to supporting partners with this new capability.

Example of IDA compliant (green dot) and non-IDA compliant exterior lighting fixture analysis at a Park Service location. Within the GIS-based collection system, fixture characterization data (including photos) collected in the field are automatically stored in the cloud for later processing. Each point is a live link to the data that partners can later access via GIS software, ArcGIS Online, an interactive Story Map or Dashboard, or through other technologies.



Example of photometric analysis for sky brightness near Bryan's home in Ohio Northern University. The image shows sky brightness measured in visual magnitude per arc second area. This unit is the same measurement unit reported by Sky Quality Meters. However, here the camera system maps sky brightness from the horizon to the zenith over a 360° view surrounding the camera. Light domes on the horizon are clearly visible.

Over the past five years I am fortunate to have been heavily involved in various projects throughout North America focused on efforts to preserve and protect the natural night sky as a cultural, ecological, and scientific resource. Many of the projects I've completed are at sites within the Colorado Plateau and I'm grateful to all who have provided their energy, insight, and time in protecting the natural night sky throughout this incredible region.

Collectively, all of you have done excellent work raising public awareness about light pollution, promoting better dark sky friendly lighting design, and protecting nightscapes through the IDA's International Dark Sky Places program. Keep up the inspiring work!

BRYAN'S CONTACT INFO

Bryan Boulanger
Professor of Environmental Engineering
Department of Civil and Environmental Engineering
Ohio Northern University
525 S Main Street, Ada OH 45810
419.772.2375
b-boulanger@onu.edu

If you are interested in doing a lighting inventory there are many resources available to you. Please contact the BRDSC coordinator or email us at *brdarkskies@gmail.com* to discuss options to better understand how lighting in your community, park or special area could be improved with a lighting inventory.

LINKS TO LEARN MORE

- *Worksheet adaptation* of Bryan's lighting inventory.
- *Dark Sky Assessment Guide* workbook guides users through several evaluation methods which could be used for a general assessment of dark sky friendly lighting in a community.
- *Example lighting inventory dashboard* showcasing data for 487 public light fixtures in Helper, UT.
- *Learn more about ArcGIS Field Maps (Collector).*