

The Economics of the Night Sky

By Alice O'Neal-Freeman, '27



[Link](#) to NPS Great Sand Dunes after dark site, with video

Great Sand Dunes National Park and Preserve, Milky Way over dunes.
Photo by National Park Service | Patrick Meyers.

Five students and two professors stand, gazing up at a sky full of stars. It is Colorado College's second block break of Fall 2023. Colorado's Great Sand Dunes National Park and Preserve was designated an International Dark Sky Park in 2019, and they can see the Milky Way. They are surrounded by sand dunes which extend about 30 miles along the western slope of the Sangre de Cristo Mountain Range. Tourists cross oceans and state lines to reach the dunes, which are the tallest in North America. Professors Guanyi Yang, Mark Eiswerth, and their team of students had spent the day surveying visitors at the Park. They talked to dozens of people about the significance of the night sky in their experience of the Great Dunes.

The research project integrated the ecological and economic aspects of light pollution as well as integrating CC and the University of Northern Colorado. Dr. Yang is an assistant professor of Economics and Business at CC who partnered with Dr. Eiswerth, a professor of Economics at UNC. Three CC students and two UNC students joined them. I contacted Dr. Eiswerth and Liam Mullen, one of the CC student researchers, to learn more about their research and experience.

Titled Tourism Response to Dark Sky Conservation at the Great Sand Dunes National Park and Preserve, Dr. Yang and Dr. Eiswerth's research project delves into the economic value of conserving starry skies. When asked why he chose to research this topic, Dr. Eiswerth explained that he has "been very concerned about the negative impacts of night light pollution for quite some time now," and that "it simply seems somewhat sad that we, as well as our children and grandchildren, are not able to see stars at night in the same way that preceding generations may have been able to."

Light pollution's effects have been well studied environmentally, but less so economically. Artificial night lighting can disrupt species' foraging, communication, and reproduction behaviors, all essential to survival (Longcore and Rich). Dung beetles navigate by the stars (Cuda Kroen), and harbor seals direct their long swims by the night sky (Sokol). In addition, much research has been conducted on the economic costs of wasted artificial light.

But what about the economic value thousands of visible stars bring by means of tourism? How many people would

continue to visit natural spaces if the clear starry skies were diluted? Are pristine night skies economically beneficial to conserve?

This final question is the one Dr. Yang and Dr. Eiswerth posed for their project. With this in mind, they crafted a survey to track demographics, how much people valued a trip to the Park, and possible change in their visitation behavior if the night sky at the Great Sand Dunes had the same amount of visibility as where they lived. Their goal was to measure current visitation behavior and predict future visitation behavior if night sky visibility changed. Their survey hammered out, they headed to one of five Dark Sky designated national parks in Colorado to survey the public. The heavily trafficked Great Sand Dunes National Park and Preserve proved a perfect location for their research.

Liam Mullen, a rising senior majoring in economics at CC, told me about the day to day process of conducting surveys in the Park. He said that the experience was "pretty fun," and "it was a nice time of year to be there." Liam also enjoyed the experience of their collaboration with Fred Bunch, the Chief of Resources Management at Great Sand Dunes.

They surveyed for three days, doing two sessions daily and breaking for lunch in between. According to Mullen, many people were receptive to their request for participation in a survey, and agreed. In total they surveyed 367 people (Eiswerth et al.). Dr. Eiswerth commented that “in-person survey work is always very challenging. It is not easy, and it requires a special recipe of attention to detail, dedication to working long hours, and strong interpersonal skills in terms of interacting with the public. Our team of students did marvelously in this regard and, due to their skills and enthusiasm, we met with success despite the difficulties that are always encountered in such field work.”

Upon return to CC, they used the data they collected to answer the research question of the value of dark sky conservation. They analyzed the data, including the survey data in addition to the geolocation data of the survey participants. First, the student researchers input the raw data into Excel.

Dr. Yang collaborated with the students on the data analysis, and Mullen retrieved the geolocation of the survey participants from VIIRS (Visible Infrared Imaging Radiometer Suite) data based on visitors’ home zip codes. VIIRS provides earth imagery from a shared satellite between NASA and NOAA. Mullen pulled VIIRS Day/Night Band (DNB) data in order to quantify the light pollution in other areas of the country. They then compared the night sky visibility at Great Sand Dunes to that of their survey respondents’ home regions, as well as that of nearby Alamosa and Breckenridge.

Drs. Yang and Eiswerth are still polishing the final report, and they hope to get it published in an academic journal. Therefore, the findings are somewhat “under wraps,” as Mullen puts it. However, broadly speaking, their findings indicate that the majority of those surveyed have college degrees and come from suburban areas. A little more than half of them had seen the night sky at Great Dunes. Importantly, almost half of

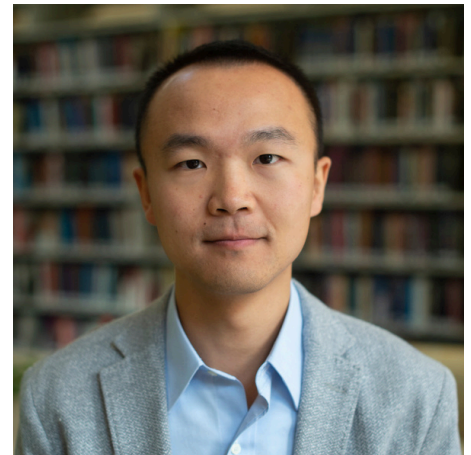
all respondents asserted that they would spend less time at the Park if it had the same night sky as their home.

The professors analyzed the data for the economic impact of increases in night light pollution. To do so, they calculated estimates of the annual decrease in local spending at the Park if there are increases in night light pollution. Their preliminary results suggest that there would be losses of hundreds of thousands of dollars if there was more light pollution (Eiswerth et al.).

So why is this research significant? Well, Dr. Eiswerth states that it has been a “chance for [the] team to make a contribution on a topic on which very little research has been conducted to date.” The economic value of dark skies is novel information with potential impact on environmental policies.

This study unveils possible economic losses if light pollution increases at Great Sand Dunes National Park and Preserve. Indeed, one wonders if this pattern would hold at Dark Sky sites throughout the country. Perhaps this study will catalyze more research on the topic.

Ecologically, the loss of clear night skies has had devastating effects, yet continued development and with it glaring night lights grind on. Artificial night lighting is fatal to a third of the insects that congregate around it every night (Daley). At the bottom of the food chain, the loss of these insects has a domino effect throughout ecosystems. Nevertheless, 9,500 new apartment units are being built in Colorado Springs alone, many in rural areas. Lights are usually on around the clock at these sites. However, with extensive financial losses uncovered by Drs. Yang and Eiswerth in the equation, the case for conserving our night skies may just be strengthened. ▲



Guanyi Yang is a computational macroeconomist whose research focuses on inequality and labor market frictions. His work explores the impact of these frictions on welfare loss during recessions and the factors that contribute to income and wealth inequalities over time. Growing up in a mining town in China has given him a unique perspective on the anthropogenic impact of resource extraction on local communities, which informs his research on economic development and community well-being in the Rockies region. Through his work, Guanyi seeks to deepen our understanding of the relationship between economic policies, development practices, and the social and environmental landscape of the Rockies region.



Mark Eiswerth is an Economics professor at the University of Northern Colorado. He worked with Guanyi Yang in 2022 and 2023 to conduct dark sky conservation research at Great Dunes and has been a visiting professor several times over the last few years in the Economics Department at CC. His research focuses include Environmental and Natural Resource Economics.



From left to right: Guanyi Yang, Liam Mullen (CC), Benjamin Slater (CC), Avery Morgan (UNC), Duaa Nakshbandi (UNC), Jacob McDougall (UNC), and Mark Eiswerth surveying at the Great Dunes. Photo taken by unknown Great Dunes visitor

References

Cuda Kroen, Gretchen. "Dung Beetles Navigate by the Milky Way." *AAAS Articles DO Group*, 24 Jan. 2013, <https://doi.org/10.1126/article.26499>. Accessed 22 July 2024.

Daley, J. The Devastating Role of Light Pollution in the 'Insect Apocalypse' *Smithsonian Magazine*. 25 November 2019, <https://www.smithsonianmag.com/smart-news/light-pollution-contributes-insect-apocalypse-180973642/>

Eiswerth, Mark, et al. *Tourism Response to Dark Sky Conservation at the Great Sand Dunes National Park and Preserve*.

Experience the Night - Great Sand Dunes National Park and Preserve (U.S. National Park Service). www.nps.gov/grsa/planyourvisit/experienthenight.htm.

Longcore, T. and Rich, C., "Ecological light pollution." *Frontiers in Ecology and the Environment*, 2004, 2: 191-198. [https://doi.org/10.1890/1540-9295\(2004\)002\[0191:ELP\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2004)002[0191:ELP]2.0.CO;2)

Meyers, Patrick. "Great Sand Dunes National Park and Preserve, Milky Way over Dunes." *Dark Sky*, 5 May 2019, darksky.org/news/great-sand-dunes-designated-as-international-dark-sky-park.

Sokol, Joshua. "What Animals See in the Stars, and What They Stand to Lose." *The New York Times*, 29 July 2021, www.nytimes.com/2021/07/29/science/animals-starlight-navigation-dacke.html. Accessed 22 July 2024.