The (Un)shining Star of the Caribbean

By Yogani Govender and Elizabeth Padilla

Mainstreaming protected areas into planning, policies and programs

Background: According to the International Dark-Sky Association (2014) light pollution refers to any negative effects caused by artificial light. This phenomenon affects biodiversity, is a threat to human health, hinders enjoyment of nocturnal nature and ecosystems and is a waste of energy that contributes to climate change (http://www.darkskyparks.org/light-pollution/problems#1). Animals and plants live by a rhythm which is tuned to our planet's 24-hour rotation. It is an inherited trait, which is passed on through the genes of a species. For example, because female sea turtles prefer to nest on very dark beaches, light pollution on coastline severely reduces the possible nesting sites, further sea turtle hatchlings crawl instinctively toward the relative safety of the ocean because of its reflection of the moon and stars. Light pollution can confuse the hatchlings and cause them to crawl away from the ocean and onto roads or into communities. If they do not find their way back to the ocean, they could become fatally exhausted or dehydrated. To face these and other impacts on wildlife and human health, numerous actions are being taken internationally in order to reduce the effects of light pollution.

Purpose: Whereas "The Shinning Star of the Caribbean" was a marketing term coined to showcase Puerto Rican progress during the latter half of the 20th century, the production of nocturnal global maps in 2000 showing artificial sources of light—especially for the Caribbean region (Cinzano *et al.* 2001) (Fig 1)—has highlighted quite a different reading on the term. Puerto Rico is indeed a "Shining Star of the Caribbean" but for the wrong reason. That is, light pollution.

Tackling this problem in and around of the natural areas we protect, which features one of the few bioluminescent bodies of water in the world, we embarked on an advocacy

and education initiative named “Puerto Rico Shines Naturally” (Puerto Rico Brilla Naturalmente in Spanish).

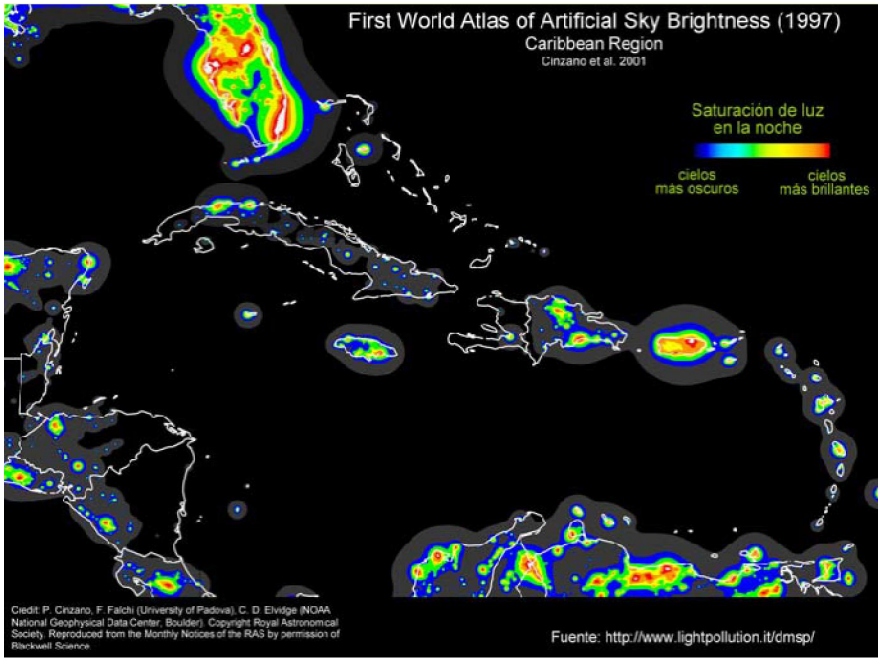


Figure 1: Artificial brightness of the sky in the Caribbean

Actions taken and results: The advocacy and public policy component of this initiative involved the development of legislation for a better management of light contamination. Like other pollutants, the problem of light pollution cannot be solved without legislative action to provide governmental parameters and to organize human actions and behavior related to light pollution. In 2007 the Light Pollution Advisory Committee (CACL) was created. Scientists, architects, government officials, representatives of academic institutions and non-profit organizations joined in the committee, interested in addressing the management of light pollution. The CACL was assigned the task of setting out strategies for implementing the necessary measures to reduce light pollution in Puerto Rico.

Taking a leading role within the CACL, our organization was vocal in order to get Law 218 of 2008 passed for the regulation of the reduction of light pollution throughout the

islands of Puerto Rico. The law sets rules to prevent excessive and unnecessary light emissions into the night sky and to keep artificial light intrusion away from properties and natural areas where it's unwanted. It includes outdoor classification and designation of special areas, as well as requirements for outdoor lighting emitting sources, prohibitions, requirements for installation and operation of lighting systems ads, exclusions, transition period, compliance plans and waivers (Microjuris, 2014).

The policy set forth by the law has the following objectives: (1) implement the environmental public policy regarding the control and prevention of light pollution; (2) establish general and specific prohibitions; (3) establish the general provisions for the control and prevention of light pollution; (4) avoid excessive and unnecessary emission of light into the night sky, and avoid artificial light intrusion into properties and natural areas where it is unwanted; (5) to present basic and general recommendations on the use of lighting and proper guidance for lighting lamps; (6) promote and encourage changes in the use of existing systems and lighting technologies in compliance with applicable regulations; and (7) implement the public policy of the Commonwealth of Puerto Rico regarding lighting levels of street lighting on roads, streets, highways, sidewalks and street lighting facilities of state and municipalities (Microjuris, 2014).

Together with the CACL, we embarked on a pilot study to manage light pollution around one of the natural areas we protect, Cabezas de San Juan Nature Reserve, around the neighborhood of Las Croabas in Fajardo (Fig 2). It showed more light pollution than other surrounding areas in the northeastern part of Puerto Rico (Ramos, 2003).

The study showed that light pollution is one of the most rapidly increasing threats to the natural environment in Puerto Rico since 1992. This pilot project site was purposely selected, as it surrounds one of the most visited bio-bays of Puerto Rico. Bioluminescent lagoons and bays exist in a very limited number of locations

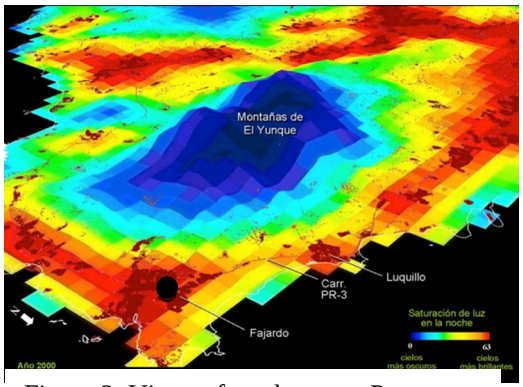


Figure 2: Views of northeastern Puerto Rico illustrating the coverage of artificial light at night
in a three-dimensional model, 2000. Black dots shows Las Croabas community.

throughout the world, and three of them are located in Puerto Rico, which draws thousands of tourists from around the globe each year.

Bio-bays are fragile ecosystems containing microorganisms called dinoflagellates, which produce faint flashes of light with the slightest movement caused in the water that surrounds them. To ensure the appreciation of this unique phenomenon and to protect the health of this bio-bay in Fajardo, we developed an educational program to engage local communities, tour operators and tourists to the region, among other interest groups.

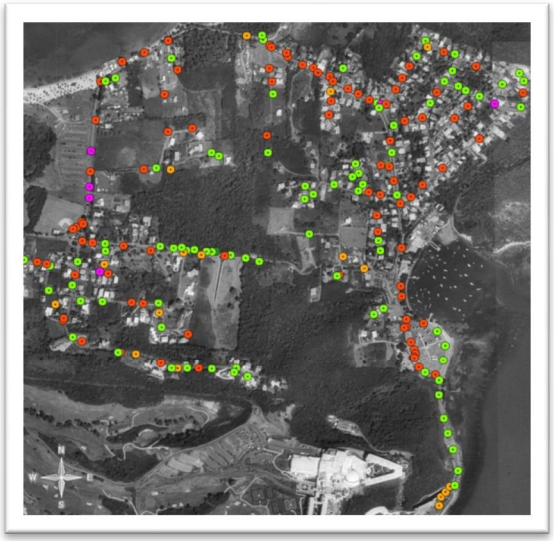
To better understand the relationship between pollution and the brightness of the bio-bay, we allow long-term monitoring of light pollution within the nature reserve, sharing environmental data collected by volunteer citizen scientists and researchers documenting water salinity, temperature, tide levels, wind speed, night sky darkness and ambient temperature.

The initiative had two components (phases). The first one was a census to evaluate and replace light fixtures to reduce glare and unnecessary energy cost in communities surrounding the bio-bay. The study site (surroundings) was divided in six working zones. The main questions to answer for each zone were:

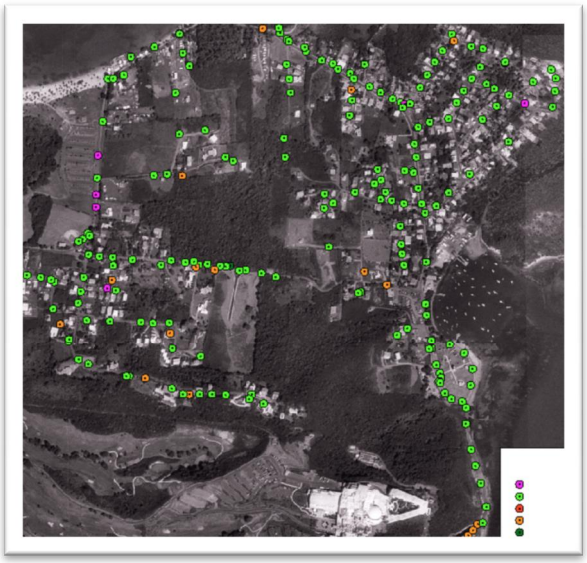
1. Are the light fixtures in particular locations necessary? If the answer was yes, then the next question asked was:
2. Is the light fixture appropriately illuminating the area and is the illumination focused or dispersed? If the answer is Yes to both questions, then the evaluated light fixture appropriate, but if the answer is No, then the next step was to evaluate what type of light fixture would be recommended to the replace fixture in order to avoid the light pollution.

During the census with the CACL, we identified over 427 light fixtures that needed to be replaced in the Las Croabas Community (Fig. 3). Seven years later, with the support of neighbors and members of the CACL, 50% of the lighting system was changed. The simple actions of education and outreach resulted in the scale of the SQM to be reduced

by 1 unit. The SQM is the unit measure used by the International Dark Sky Association (IDA) to measure the night darkness (Fig 4). At the beginning of this initiative in 2008, we had measured an average of SQM 19 in the area, today in 2014 it measures at 20 SQM.



Before education and outreach initiative



After education and outreach initiative

Figure 3. Comparative of light fixture replacements to reduce glare and unnecessary energy cost in communities surrounding the bio-bay. Red dots indicate light fixtures that needed to be changed after the first census.

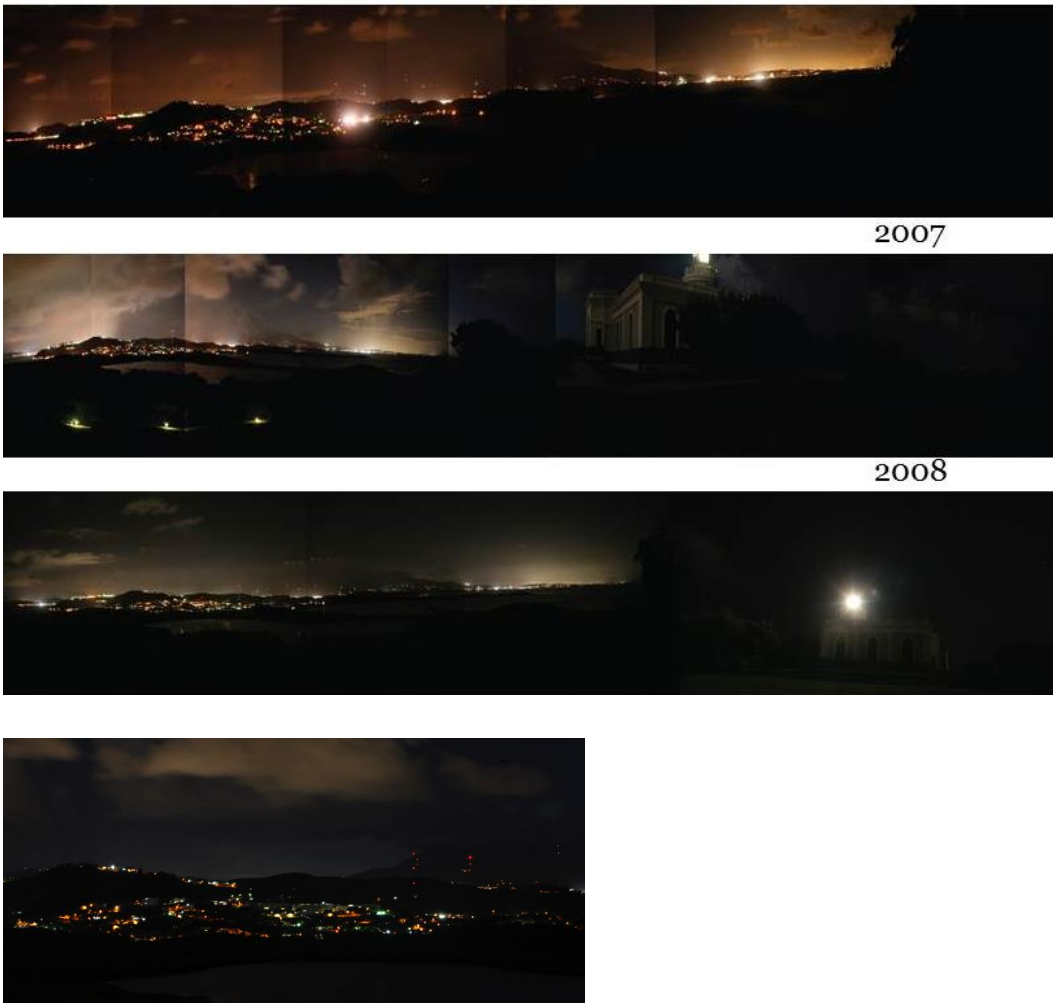


Figure 4: Temporal changes of light pollutions around bio-bay in Fajardo Puerto Rico showing reduction of 50 % of light pollution.

The second component or phase of the initiative is the educational aspect. A special working group consolidated four topics: ecological effects, astronomy effects, human health, and energy consumption attributed to the public, to create educational tools and strategies for the general public. The specific strategies developed and actions taken were:

- Development of educational materials e.g. highlighting the correct installation of light bulbs, redirecting light down to only where it is needed, types of light bulbs with correct lamp wattage that reduce unnecessary spill of light.

- Lectures to community and local organizations.
- Working in collaboration with municipal government.
- Working in collaboration with the tourism industry. For example, neighboring El Conquistador Resort changed its light bulbs in all north-facing rooms.
- Offered night educational tours with the participation of over 12,000 people in 7 years.
- Evaluating and replacing all lighting within the nature reserve.

- Coordinating with the USCG to block the historic Fajardo Lighthouse on its landward side to reduce light pollution over the bio-bay.

For all efforts undertaken as part of the Puerto Rico Shines Naturally initiative, we were awarded the prize for "Best Environmental Initiative" by MAPFRE (Spain) in 2012.

Figure 5. Community participation in night tours at Cabezas de San Juan Nature Reserve that are still part of the initiative's educational activities tackling light pollution.

Broader impacts: Today Para la Naturaleza is in the process of applying for a Dark Skies Certificate from the International Dark Skies Association. Citizens are also using Law 281 of 2008 to educate and defend their homes from light pollution coming from digital billboards and electronic signs, as was reported in the news article "Grito santurcino contra los billboards" published in INDICE, May 23, 2014. The newspaper describes how neighbors of Santurce are fighting against light pollution. The widespread use of electronic signs has created conflicting interests in the last years. While the billboard companies seek to expand the use of these devices, citizens are increasingly opposed because of concerns about driver security due to distraction and sleep deprivation, among other environmental issues associated with light pollution.

Lessons learned: The "Puerto Rico Shines Naturally "initiative involved multi-sectorial participation in order to achieve these results, starting small in a single geographic location enable staff to focus light pollution management efforts and engaged local communities and stakeholders to be part of the transformative process. The education and outreach initiative must be carefully planned according to institutional needs as intense time and effort was involved from Para la Naturaleza staff to facilitate the transformation of residential and business owners. As in all education initiatives careful planning must go into the financing and marketing for them to be successful. Many citizens are not aware of the impacts of light pollution and through this initiative Para la Naturaleza learned that informed citizens take action.

About us: We are Para la Naturaleza, a nonprofit unit of the Conservation Trust of Puerto Rico. Our goal is to integrate society at large in the conservation of natural ecosystems, in order to increase the amount of protected lands in Puerto Rico, from the actual 8 percent, to 33 percent by the year 2033. Para la Naturaleza seeks to provide each person and each community with transformative experiences that can inspire and motivate concrete actions for nature, such as doing volunteer work, donating money and land, or establishing conservation easements.

As a unit we group all of the Trust's educational programming, volunteer and Citizen Science events, and all fundraising initiatives of the organization. We also manage all visitor centers and natural areas protected by the Trust, including Hacienda Buena Vista in Ponce, Hacienda La Esperanza in Manatí and Cabezas de San Juan in Fajardo, among others.

We operate from one of the world's most threatened biodiversity "hotspots" (Meyers et al 2000). For over 43 years, the Conservation Trust has successfully protected nearly 28,000 acres, or about 1% of the total area of Puerto Rico, impacting more than one and a half million participants through our educational, volunteer and Citizen Science programming. We have also rescued and restored four historic monuments and have been able to implement important public policy initiatives such as the Puerto Rico conservation easement law.

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