

# A call for urban lighting governance in the vicinity of protected areas

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## KEYWORDS

light pollution, earth observation, lighting governance, spatial modeling, human impact

## EXTENDED ABSTRACT

In this paper we highlight the importance of “*urban lighting governance*”, i.e. control and management of artificial night lighting, particularly in close proximity to protected areas, and raise awareness of the issue of light pollution and related ecological consequences. The footprint of human occupation is uniquely visible from space in the form of lights at night, ranging from the burning of the rainforest to massive offshore fisheries to the omnipresent lights of settlements and connecting road networks (Elvidge et al. 2001). Increasing research activities on the ecological consequences of artificial night lighting in recent years have attracted the attention of both scientists and journalists (Rich & Longcore 2006, Klinkenberg 2008). The term light pollution is widely used referring to any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste.

The National Oceanic and Atmospheric Administration, National Geophysical Data Center (NOAA-NGDC) processes and archives data acquired by the U.S. Air Force Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS), which was initially designed to monitor the global distribution of clouds using visible and thermal infrared spectral bands. At night the visible band signal is intensified with a photomultiplier tube enabling the detection of moonlit clouds. The boost in gain provides this sensor with the unique capability of observing lights present at the surface of the Earth at night. Considering nighttime lights as a proxy for anthropogenic activities that also influence neighboring regions enables a globally consistent analysis of exposure to potential human impacts. The assessment of exposed ecosystems and related loss of biodiversity is essential in the context of the climate change debate whereas monitoring and protecting the diversity of life on Earth is one of the ‘global issues’ affecting society. UNEP’s World Conservation Monitoring Centre (WCMC) provides information on spatial distribution and delineation of protected areas (World Database on Protected Areas, WDPA). Based on analysis of the two data sets we developed a set of spatial indicators describing the exposure of protected areas to artificial lighting and thereby approximated human influence.

Initial results of the analysis indicate that protected areas in Europe and Asia Minor, the Caribbean, South and East Asia as well as in the Eastern part of the United States are most exposed to anthropogenic light pollution (Aubrecht et al. 2010). Introducing aggregated data on biomes reveals that protected areas in temperate broadleaf and mixed forests are most affected. These findings are in accordance with a previous assessment of biomes at risk where global land cover data were used as indicator for human impact (Hoekstra et al. 2005). Derivates of DMSP data were already used previously to estimate light pollution in U.S. Class 1 Federal Areas<sup>1</sup>. These artificial sky brightness maps were modeled using radiance calibrated nighttime lights as input to a radiative transfer model. Radiance calibration is however not yet implemented in operational DMSP products, which is why we use standardized stable lights data.

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<sup>1</sup> [www.trianglealumni.org/mcrol/class1.html](http://www.trianglealumni.org/mcrol/class1.html) (last accessed: 28 June 2010)



*Figure 1: Left - Nighttime satellite image of Europe as derived from DMSP-OLS. Right - Light pollution on Tenerife, Canary Islands (photo by cestomano.com, May 2008).*

Our assessment and discussion of protected areas' exposure to light pollution and related ecological consequences underscore the need for an urban lighting governance framework to protect the natural environment. There has been much debate on the control and directionality of lighting in the last two decades. One country which serves as a good example in this context is the Republic of Slovenia, where in August 2007 a Lighting Law was adopted, prohibiting light above the horizontal and requiring the use of shielding for most luminaires (Mizon & Morgan Taylor 2008). Other countries have not yet reached a comparable level of official acknowledgment. However, 'rules for lighting' are proposed and related fights for legislative measures are going on in several countries such as the Czech Republic (Hollan 2003), Switzerland (Righetti 2007), and Germany (Hänel 2009). Improving conditions assumingly caused by law-enforced management activities against light pollution were observed on the Hawaiian island of Oahu in a satellite based analysis of trends of lighting impact on coral reefs (Aubrecht et al. 2009). The presented analysis helps indicating which protected areas are most exposed to human influences. This call for urban lighting governance in the vicinity of protected areas is an important step towards public communication and raising awareness on the topic of light pollution and its ecological consequences.

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