

ASSESSMENT OF LIGHT POLLUTION IMPACT ON PROTECTED AREAS IN CHINA

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ABSTRACT:

The Protected Areas (PAs) with natural, ecological and cultural value play important role in biological processes, biodiversity and ecosystem service. During the past years of rapid urban expansion in China, the spatial range and intensity of light pollution unprecedented increase. Historically, optical remote sensing and field survey data had been used to reveal that human activities impacted on PAs for individual areas and few papers documented the issue of light pollution impact on PAs at national scale. Here, time series night-time light satellite images of Defense Meteorological Satellite Program Operational Linescan System (DMSP-OLS) were selected to assess the light pollution impacted on PAs in China. The method we proposed can be effectively applied to assess the impact of light pollution on PAs and the percent of dark PAs decreased by 35.38% from 1992 to 2012 at nationwide. The trend of light pollution of most PAs in stable, however, light pollution of the local area is increase significantly, especially in northern Xinjiang, Gansu, Xizang, Yunnan, Jiangsu and Shandong. Considering the current status of light pollution encroach into PAs, two strategies of appropriate buffer zone and wide measured for light pollution are also recommend.

1. INTRODUCTION

Protected Areas (PAs), which cover 12% of Earth's land surface, play an important role in the biodiversity and ecosystem service and can contribute to species abundances and ecosystem functions(Loucks et al., 2008). With rapid social and economic development across worldwide, the extent and intensity of human activities are unprecedentedly expanding. Due to poor management and lack of monitoring, these activities have caused function degradation of PAs in local areas, thus, it severely threatens to the sustainable development of protected PAs(Gaston et al., 2015b). The impact of human activities on PAs is complexity and diversity. Among the various influencing factors, it is recognized that land-use change driven by urban expansion is a key factor affecting PAs (Shafiee et al., 2015). Light pollution is the comprehensive results of land-use change and socio-economic development (Gallaway et al., 2010). Particularly in the recent two decades, earth surface has been illuminated by nightlight at night. Light pollution has been universal environmental issue(Bennie et al., 2014). However, this issue is still not attracted wide attention. In the recent years, the impact of light pollution on ecosystem has been documented(Bennie et al., 2015), furthermore, some study also focus on the organismal level to discuss the influence on sleep(Raap et al., 2015), flight trajectory(Rodriguez et al., 2015), spawning(Mazor et al., 2013).

Compared with the traditional survey methods, remote sensing observation means is more efficient and low cost. With the rise of night-time light remote sensing, night-time light satellite image has been widely used in various fields, such as socio-economic parameter simulation(Rybnikova and Portnov, 2014),

urbanization process assessment(Liu et al., 2012), humanitarian assistance(Li et al., 2013a; Li and Li, 2014), ecological environment(Aubrecht et al., 2008). As well as, night-time light remote sensing also greatly enhances the light pollution exploration and it has become an indispensable technology for light pollution assessment(Bennie et al., 2014).

In the recent years, night-time light remote sensing has been used in light pollution assessment and the impact of light pollution on the ecosystem (Bennie et al., 2015; Gaston et al., 2015a). Defense Meteorological Satellite Program's Operational Linescan System(DMSP-OLS) night-time light image, landcover product and global ecosystem types were combined to assess light pollution exposure at global scale(Bennie et al., 2015). Gaston proposed a method to quantify the erosion of light pollution in the global protected areas system using calibration night-time light satellite data(Gaston et al., 2015a). The study suggested larger PAs were influenced by light pollution slightly, however, smaller PAs have experienced significant increase of light pollution. Furthermore, Davies assessed the light pollution exposure of marine protected areas and found that artificial light had increased across most marine protected areas(Davies et al., 2016).

As many globally important PAs located in China, it is urgent to assess the impact of light pollution on PAs. Additionally, evidence shows that PAs have been disturbed by human activities(Ebbensgaard, 2015). Therefore, assessment of light pollution impact on PAs in China is extremely needed from national scale. Based on advanced night-time light remote sensing technology and Geographic Information System (GIS)

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