

基于多源遥感的大熊猫国家公园光污染时空动态与生态边缘效应

摘 要:【目的】保护地和荒野地区越来越多地受到光污染的侵蚀。大熊猫国家公园作为中国南北跨度最大的国家公园,评估其光污染并探索特征,对生物多样性保护、国家公园管理和可持续发展具有积极价值。因此,本研究分析了过去 30 年间大熊猫国家公园光污染变化的时空趋势;评估了人类活动和土地开发强度是否影响大熊猫国家公园光污染。【方法】本研究使用夜间卫星遥感影像的平均夜间辐射强度来评估光污染水平;基于景观生态学方法测量景观指数以评估光污染特征;计算公园内和公园外 10 公里缓冲区内的建筑面积和人口密度,以评估公园内外的土地开发强度和人类活动。【结果】结果表明,过去 30 年间,大熊猫国家公园光污染显著增加,NTL 平均值和光污染斑块面积增长了 17 倍,平均光照强度上升了 3 倍以上;公园边界复杂的区域受光污染影响更显著。平均夜间辐射受公园外建筑和人类活动的影响更为显著,外国人造光是大熊猫国家公园光污染的主要来源,光污染可以被视为土地开发受到严格限制区域的生态边缘效应。【结论】国家公园规划中应当尽可能保持公园边界形状简单化,并减少公园形状斑块数量;通过多种方式对国家公园人类活动和建设进行集中规划和管理;在公园内部和外围都需要控制灯光,保护生物多样性免受光污染。本研究结果将为国家公园规划管理、光污染防治和指导措施的实施提供参考。

关键词:夜间灯光遥感;景观指数;时空趋势;土地利用;生态边缘效应

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Spatial and Temporal Dynamics of Light Pollution in Giant Panda National Park based on Multi-source Remote Sensing and Ecological Edge Effects

Abstract: 【Objective】 Protected and wild areas are increasingly encroached upon by light pollution. Giant Panda National Park, the largest national park spanning from north to south in China, assesses its light pollution and explores characteristics that are of positive value for biodiversity conservation, national park management, and sustainable development. Therefore, this study analyzed the spatial and temporal trends of light pollution changes in Giant Panda National Park over the past 30 years; assessed whether human activities and land development intensity affect light pollution levels in Giant Panda National Park. 【Method】 In this study, light pollution levels were assessed using the average nighttime radiation intensity from nighttime satellite remote sensing images. A landscape index was measured based on landscape ecology methods to assess light pollution characteristics. Floor area and population density within the park and within a 10 km buffer zone outside the park were calculated to assess the intensity of land development and human activities inside and outside the park. 【Result】 Light pollution in the Giant Panda National Park has increased significantly over the past 30 years, with a 17-fold increase in the average NTL and the area of light-polluted patches, and a more than 3-fold rise in average light intensity. Areas with complex park boundaries are more significantly affected by light pollution. Mean nighttime radiation is more significantly influenced by buildings and human activities outside the park. Exterior artificial light is the main source of light pollution in Giant Panda National Park. Light pollution can be considered as an ecological edge effect in areas where land development is severely restricted. 【Conclusion】 National park planning should keep the shape of park boundaries as simple as possible and reduce the number of park-shaped patches. Central planning and management of human activities and construction in national parks are carried out in various ways. Artificial light control is needed both inside and outside the park to protect biodiversity from light pollution. The results of this

study will provide a reference for implementing national park planning and management, light pollution prevention, and guidance measures.

Key words: nighttime light images; landscape index; spatial and temporal trends; land use; ecological edge effects.