A Review on the Effects of Artificial Lighting on Marine Ecology in Seaport Terminals

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Abstract

In recent years, excessive or improper application of artificial lighting has had resulted serious environmental consequences, scientifically known as Light Pollution. The night sky and ocean close to transportation terminals are illuminated by a variety of artificial lights, including high-mast lights, navigation lights, security/emergency lights, crane and equipment lighting, LED floodlights, and dock lighting, in addition to the primary natural light sources of sunlight, moonlight, stars, and bioluminescent light. These high-intensity lights have been shimmering along the coastlines, creating a pathway for light pollution and its effects. Research on optical oceanography and ALAN (Artificial Light at Night) impact is expanding globally. However, there is a great dearth of research regarding light pollution related to seaport terminals in Sri Lanka as ALAN is relatively a new area of analysis. The aim of this narrative review paper is to address the question, "what are the ecological impacts of artificial lighting from seaports on marine life" and to raise policymakers' awareness on potential threats marine ecology. Scopus, Google Scholar databases and IMO publications were used for the scientific literature search. Terminal lighting is crucial factor in a seaport for safety, security, and efficiency of movement of people and commodities during around-the-clock operations and the vertical and horizontal light in buoys and beacons are crucial for hazard avoidance in ships. Standards of IMO and International Commission on Illumination (CIE), minimum illumination levels, color temperature levels, and Color Rendering Index are maintained at sea ports for safer navigation and operations. Terminal light emissions beyond shorelines, disrupt delicate underwater ecosystems in pelagic zones and coastal areas. According to literature, around 2 million km² of the world's ocean at a depth of 1 m are affected by light pollution. ALAN impacts include changes in predator- prey interaction patterns of fish, coral spawning, zooplankton diel vertical migration (DVM), and seabird / sea turtle navigation. LED lights' white illumination, adversely affect the recruitment and colonization of marine epifaunal communities like sessile and mobile invertebrate species. Regulations mandate light intensities, luminous intensity, and spectral power distribution units, focusing on human vision, but similar visual metrics should be developed considering the marine and nocturnal animals for more sustainable and environmentally friendly practice. The scientists have developed the Light Pollution Index (LPI) to measure the ALAN impact at night sky. Additionally, strategies like WWF earth hour, green space management and light flow control also used to mitigate the ALAN impacts in infrastructure development. Effective mitigation strategies further include proper placement/direction of vertical beam spread, removing excess lights, reduce uplighting & residual effects, installing timers or dimmers, and using shielded lighting fixtures. Additionally, raise awareness on light pollution, as the DarkSky International, have shown measurable impacts on urban light levels. Inarguably the night sky and marine ecosystems are at threat due to ALAN impact caused by seaports and nearby urban structures. There's a

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growing need to include the effects of light pollution analysis in port master plans. This study emphasizes that careful analysis and preventive strategies exist to constrain and to reduce the ALAN impact of seaports while ensuring safe and efficient operation.

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