

Impact of light Pollution to Ecology

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ABSTRACT

Pollution is a term that most of us are familiar with. While pollution in the air, water, land, and e-waste is well-known, we rarely consider light pollution, which is a source of energy for the web of life and is dependent upon and determined by day and night, light and dark. However, artificial lighting also adds to the so-called "light pollution," as it has become necessary to support human activity at night. When this kind of pollution happens, the night sky becomes less visible and needless energy is wasted. The misuse or overuse of artificial light has detrimental effects on the environment that affect wildlife, people, and our climate. Thus, the influence is the main emphasis of this study.

INTRODUCTION

Light pollution refers to the excessive or misdirected artificial light produced by human activities, which disrupts the natural darkness of the night sky. This phenomenon has become a global concern due to its adverse effects on the environment, wildlife, human health, and astronomical observations. Artificial lighting is one of the main causes of "light pollution," as it has become necessary to support human activity at night. It leads to needless energy waste and a deterioration in the night sky's visibility. Because of artificial night lighting and the unrestricted growth of human habitation in and around natural habitats, people are directly exposed to rich ecosystems nearby. In addition to destroying the breathtaking view of the cosmos, this growing and pervasive usage of artificial light at night also has an adverse effect on our environment, energy use, and health. Generally speaking, there are two types of light pollution: excessive light and bothersome light, or indoor and outdoor light pollution. including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste." Before 100 years ago, everyone could look up and could see the beautiful and spectacular view of night sky but now a days due to the urbanisation and industrial civilisation millions of children across the world never experience the Milky Way where they live. Astronomy is very sensitive to light Sky glow over the large cities is a major issue for many astronomers across the globe because it obscures stars, even in perfectly clear nights. Global experts have reported that in many urban areas of Europe and North America, the sky brightness is at least two to four times higher than average. Light pollution can have negative health impacts, including increased stress, anxiety, weariness, and recurrent headaches. Furthermore, it is shown that light pollution eliminates nitrate radicals, impeding the typical nocturnal decrease in air smog caused by vehicle and industrial emissions. Preserving the night sky is therefore an important first step toward maintaining biodiversity.

Causes of light pollution

- **Urbanisation:** Rapid urban development leads to the proliferation of artificial lighting in cities and suburbs.
- **Industrialization:** Industrial facilities often use bright lights for security and operational purposes, contributing to light pollution.
- **Advertising:** Outdoor advertising signs, billboards, and illuminated displays contribute significantly to light pollution.
- **Street Lighting:** Inefficient and poorly designed streetlights can emit excessive light upward and sideways, contributing to sky glow and glare.
- **Residential Lighting:** Excessive outdoor lighting in residential areas, including decorative and security lighting, adds to light pollution.



Fig : Light pollution

Types of light pollution:

- **Sky Glow:** Sky glow refers to the brightening of the night sky over inhabited areas, primarily caused by artificial sources of light such as urban and suburban areas. It obscures the view of stars and celestial objects by scattering light into the atmosphere, leading to a hazy glow above populated regions.
- **Glare:** Glare occurs when excessively bright lights create visual discomfort and reduce visibility, especially on roadways and in urban environments. Glare can be categorised into three types: disability glare, discomfort glare, and blinding glare, all of which can impair vision and safety.
- **Light Trespass:** Light trespass occurs when artificial light spills beyond its intended area, intruding into neighbouring properties, homes, or natural habitats. It can disrupt sleep patterns, disturb wildlife, and cause annoyance or discomfort to individuals living nearby.
- **Clutter:** Light clutter refers to the excessive and visually confusing array of lights in urban areas, including streetlights, signs, and advertising displays. This can create a chaotic visual environment, diminish the aesthetic appeal of urban spaces, and contribute to energy waste.
- **Over-Illumination:** Over-illumination happens when excessive or unnecessary lighting is used, resulting in higher energy consumption, light pollution, and associated environmental impacts. It often occurs in commercial and residential settings where lighting fixtures are brighter or more numerous than required for safety or visibility.
- **Artificial Sky Brightness:** Artificial sky brightness refers to the overall brightness of the night sky caused by artificial light sources. It reduces the contrast between celestial objects and the background sky, making it difficult to observe stars, planets, and galaxies.

Effect of light pollution on ecology

Light pollution has significant effects on the environment across various ecosystems. Here are some of the key impacts:

- **Impact on plants - Effect on Plants:** Nighttime waste light can significantly harm plants. During the day, plants, shrubs, and trees need sunlight for photosynthesis. However, during the night, they require darkness to replenish a crucial molecule called phytochrome, which controls several important plant processes like photoperiodism, abscission, dormancy, and seed germination. According to recent research, light pollution near lakes inhibits zooplankton, such as *Daphnia*, from consuming surface algae, leading to algal blooms that can kill the lake's vegetation and degrade the water's quality.
- **Impact on animals:** Ecological light pollution is the term used to describe how artificial light impacts living things and ecosystems. Artificial light benefits certain species while having little effect on others. For instance, certain spider species prefer to stay away from areas with light, while others are content to weave webs. A major concern posed by light pollution is to nocturnal species in particular. It can interfere with an animal's ability to navigate, affect competitive relationships, alter the prey-predator dynamic, and damage its physiological systems. There may be more roads since certain nocturnal animals that forage for food at night may become blinded.

- **Impact on birds :** Birds have heightened light sensitivity. Approximately 450 different kinds of migrating birds are dependent on the moon and star positions. The moonlight and stars guide the migration of nighttime hunting birds. Artificial light has the potential to divert them from their intended path and lead them into the perilous urban nightscapes. Millions of birds perish annually as a result of collisions with lighthouses, high-rise towers, and needlessly lit structures. For birds to continue their race, migration is a crucial and essential activity. Bird migration is influenced by indications from seasonal schedules that are appropriately scheduled. They may migrate too early or too late as a result of artificial light, missing the best weather conditions for nesting, feeding, and other behaviours.
- **Impact on reptiles:** Natural light changes provide cues to begin feeding, sheltering, mating, reproducing, and communicating, but artificial light throws off these species' circadian rhythms. Certain species are site-specific by nature; they always select a particular location for their daily activities, which are altered by artificial light. Frogs, turtles, rats, and some bats are a few examples. Although sea turtles are aquatic animals, during their molting period, particularly at night, the females approach the beach to deposit their eggs. Hatchlings identify the sea by spotting the bright horizon across the water, but the artificial light pulls them in the opposite direction, killing the just formed pups.
- **Disruption of Wildlife:** Light pollution disrupts the natural behavior and ecological processes of wildlife. Many species, including birds, insects, amphibians, and mammals, rely on natural light cues for navigation, foraging, reproduction, and predator avoidance. Artificial light at night can interfere with these behaviours, leading to disorientation, habitat fragmentation, and changes in population dynamics.
- **Altered Ecosystem Dynamics:** Light pollution can disrupt the balance of ecosystems by altering predator-prey relationships, species interactions, and food webs. For example, nocturnal predators may become more successful in hunting due to increased visibility, while prey species may struggle to detect and evade predators under artificial light conditions.
- **Disruption of Reproductive Cycles:** Many species rely on specific light conditions, such as moonlight or darkness, to cue reproductive behaviours and breeding seasons. Light pollution can interfere with these natural cues, leading to mismatches in breeding cycles, reduced reproductive success, and population declines in affected species.
- **Impact on Plant Physiology:** Artificial light at night can also affect plant physiology and growth patterns. Some plants, particularly those sensitive to photoperiods (day length), may experience disruptions in flowering, fruiting, and dormancy cycles. Additionally, light pollution can alter the behavior of nocturnal pollinators and seed dispersers, potentially affecting plant reproduction and biodiversity.
- **Changes in Habitat Structure:** Light pollution can alter the structure and composition of habitats by influencing vegetation patterns, predator-prey dynamics, and species distributions. In urban areas, for example, artificial lighting can create "bright spots" that attract certain species while repelling others, leading to changes in community composition and ecological interactions.
- **Migration Disturbances:** Many migratory species, including birds, insects, and marine turtles, rely on celestial cues such as starlight or moonlight to navigate during their seasonal migrations. Light pollution can disorient and attract these animals, leading to collisions with buildings, exhaustion, and delays in migration, which can have cascading effects on populations and ecosystems.

CONCLUSION

Overall, light pollution poses a significant threat to biodiversity, ecosystem functioning, and ecological integrity. Addressing the impacts of light pollution requires implementing measures to reduce artificial light levels, minimize its spread into natural areas, and promote responsible lighting practices that prioritise the conservation of dark skies and natural nocturnal environments. Light pollution poses significant challenges to environmental, human health, and astronomical interests. By implementing effective strategies to reduce light pollution, we can protect the integrity of our ecosystems, safeguard human health, and preserve the beauty of the night sky for future generations.

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