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LIGHT POLLUTION EFFECTS ON WILDLIFE, HUMANS AND ECOSYSTEMS

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ABSTRACT

"When we add light to the environment, that has the potential to disrupt habitat, just like running a bulldozer over the landscape can."

— Chad Moore, Formerly Program Manager of the National Park Service

For billions of years, life on earth is closely interwoven with the inevitable cycle of day and night. DNA of all plants and animals is scripted with the activities synchronised with the cycle of day and night. Inventions and innovations of human beings have radically disrupted this cycle of alternate light and darkness by lighting up the nights. Lives, life processes and activities of plants and animals depend on earth's twenty four hourly cycle of light and dark. The predictable cycle of light and darkness of nature governs the life-supporting behaviors such as, nourishment, sleep, protection from predators and reproduction. Scientific evidences suggest that artificial lightings at night time has adverse and deadly effects on many creatures including amphibians reptlies, birds, mammals, insects and plants. Light pollution, during day and night, is not only affecting animal and plants wildlife but it also has drastically adverse effects on human life and society.

Keywords: *Light Pollution, Ecosystem Balances, Gene Pool, Predator- Prey Relationship, Circadian Rhythm, Melatonin.*

Introduction

Due to exposure to light especially the frequencies of artificial bright blue or white light, the sleeping patterns are getting disturbed, which results in many psychological problems and disorders in humans, which can mainly be observed in younger people. Such disturbances are gradually leading to low work efficiency and lesser harmony and peace in our society, especially the urban society where nights are no longer dark due to artificial lighting and linger duration of exposure to strong high energy electromagnetic radiation. Much detailed study and research is needed, in coming days to find out the real implications of this pollution.

Adverse Effects of Artificial Lights

Although artificial light is one of the most significant advancements in technology by human race, it's misuse or overuse and alteration of nightcsapes is gradually altering the ecosystems of earth. One of the new entrants in the list of pollutants is artificial light, because artificial lights are now shattering most of the world's ecosystems. Nocturnal animals sleep during the day and carry out their life activities at night. In the case of nocturnal animals, light pollution drastically alters their night time environment by changing night time darkness into into day time like illumination.

It is a well known fact that significant aspects of lives of plants and animals depend on the diurnal and nocturnal influences of nature. Animal and plant physiology is not only adversely affected by light pollution but also the competitive interactions of the animals, the migratory pattern of birds, fishes and amphibians and predator-prey relations are also getting adversely affected,which is resulting in disruption of ecosystem balances. Light reflections prevent natural UV rays of cosmos from reaching the earth which is essential for the subsistence of plant life.In other words, light pollution alters the daily light and darkness rhythms and adversely alters cycles of life , thus upsetting the ecological activities.

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Recent Observations

According to research scientist Christopher Kyba, the introduction of artificial light probably represents the most drastic change human beings have made to the environment of nocturnal animals. Kyba adds that predators use light to hunt, and prey species use darkness as cover. Near cities, cloudy skies are now hundreds, or even thousands of times brighter than they were 200 years ago and we are only beginning to understand the drastic effect this has had on nocturnal ecology.

Impact on Nocturnal Lives of Animals

Hundreds of wildlife such as deer and zebras are killed on the roads in the evenings since the glares blind and distort their night navigation aspects. Glare from artificial lights also adversely affects wetland habitats. These wetlands are home to a wide range of animals such as birds, snakes, turtles, salamanders, frogs and toads of which, night time croaking of frogs and toads is a part of their breeding ritual. Artificial lights disrupt croaking timing and duration of these animals, which in turn is interfering with reproduction and reducing populations of various species of frogs and toads. Sea turtles have also been found to be highly reliant on natural lighting for reproduction, movement, eating, and development which is heavily impacted by artificial lighting. Artificial lights can lead baby sea turtles to their untimely death. This is so because, sea turtles live in the ocean but hatch at night on the beach. Hatchlings navigate their way to sea by detecting the bright horizon over the ocean. Artificial lights lure them away from the ocean to illuminated land at night time. Millions of turtle hatchlings die this way every year by falling prey or by being run over by vehicles.

Birds migrate and hunt at night. They navigate with the help of moonlight and starlight to reach their destinations. Artificial lights have ruinous effects on various bird species, as these birds are small insect eaters and migrate at night. These birds may fall in the trap of the easy food of insects around artificial lights and fail to migrate to proper destination at proper season.

Artificial light can cause them to wander off from their actual course and direct them toward the dangerous night time landscapes of cities which either result in their crashing in to glass walls with tremendous speed leading to their untimely death or results in reaching wrong destination. Each year countless birds die colliding with needlessly illuminated buildings and towers in areas inhabitated by human beings. Migratory birds depend on cues from properly timed seasonal schedules, which include natural lights of certain luminosity, which makes them reach at proper places at proper time for continuity of their life cycle. Artificial lights can cause these migratory species to migrate too early or too late and miss ideal climate conditions for nesting, reproduction , ideal food finding times and other behaviors, in addition to their reduced population by colliding with glass walls or buildings.

Sometimes these birds get trapped in the city due to artificial lighting as they get easy food and miss their usual lifecycle, resulting in missed reproduction timings or opportunities. They may also get exhausted by encircling artificial lighting and then fall on the ground to get prayed by other animals. Many insects are drawn to light, because more than half of the insect population is nocturnal, and artificial lights can be a fatal attraction due to the fact that they get exhausted by ceaselessly moving around the source of artificial light at night and loose their lives or become easy prey to nocturnal birds and animals.This also implies that food acquiring patters and techniques of many nocturnal species also gets altered by artificial lightings.

Declining insect populations negatively impact all species that rely on insects for food or pollination, this affects the diversity of plant and animal kingdom. Some predators exploit this attraction to their advantage, which in turn is altering food webs in unforeseen ways.

Impact on Wild Life Population, Ecosystem, Biodiversity and Genetic Composition

It has been found that the population of spiders is increasing in cities where there is more of unnecessary artificial lighting. In 2017, drastic declines of insects were reported by a team of scientists in Germany. The research indicated that the biomass of flying insects decreased more than 75% over the 27-year study period. Nocturnal insects depend on darkness and natural light from the moon and stars for orientation and movement or to escape from predators, and to go about for their nightly tasks of seeking food and reproducing.

In a study published in the Annals of Applied Biology, scientists from the Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), which investigated the relationship between insect population declines and artificial light at night (ALAN), there is an suggestive relation between declining insect populations and artificial lighting.

In another study, published in Science Daily, it was found that all the traditional factors which are known to affect insect populations namely, climate changes, pesticide use, and land changes etc. cannot fully explain the massive reduction in flying insect populations in the study area . In this study too, the scientists, after analysing the effects of artificial light at night on insects, found that there is strong evidence to suggest a link between light pollution and declines in insect populations. This sharp decrease in insect populations, may result in significant adverse impacts in natural and agricultural ecosystems as insects play important roles in pest control pollination,, and nutrient cycling, therefore reduced insect populations may affect biodiversity and crop production adversely.

It has been found that flying insects are attracted by artificial lights – and, at the same time, they get removed from other ecosystems and die from exhaustion or as an easy prey. An artificially lit night disturbs natural trends – and has a negative impact on the chances of survival by interfering with reproduction, communication, and thereby reducing the population of affected species.

Additionally, rows of light prevent flying insects from spreading away from each other, which causes a lack of genetic exchange within segregated insect populations that could negatively affect their resistance to other negative environmental impacts. Agriculture is closely related to ecosystem and human health and existence, which implies that the relationship between insect populations, light pollution and agriculture has to be urgently studied for better understanding of agro-ecosystems. Artificial light also affects zooplankton, which ripples through the ocean ecosystems. This affects the atmosphere above the surface of the water. This impiles that in order to further understand these relationships, research vessels need to be designed with the light sensitivity of zooplankton in mind.

Impact on Circadian RYTHM and Effect on Animal and Human Lives

Many wildlife animals such as mammals, birds, reptiles and insects are naturally photoperiodic. Many characteristics of these animals' behavior and physiology depend on the day and night influences , called as circadian rhythms. Due to this, their growth, development, reproduction, eating and locomotion all depend on the balance between day and night.

Circadian rhythm disruption is basically caused by the altered timing and altered intensity of light in reference to the circadian phase. It can also be impacted upon by too much light, too little light, or incorrect spectral composition of light. This effect is either driven by stimulus or lack of stimulus, to photosensitive ganglion cells in the retina of man and animals.

The the circadian phase and time of day is signalled , by the suprachiasmatic nucleus, to the pineal gland which is the body's photometer. Bright light in the evening or in the early morning shifts the phase of the production of melatonin. An out-of-sync melatonin rhythm can worsen cardiac arrhythmias and increase oxidized lipids in the ischemic heart.

Melatonin also reduces superoxide production and myeloperoxide (an enzyme in neutrophils which produces hypochlorous acid) during ischemia-reperfusion. Therefore, any amounts of artificial lights introduced in the environments can seriously alter the natural cycles and various life processes. Increased cases of insomnia, psychological disorders and various diseases have been related to overexposure to artificial lighting, which is not only leading to loss of peace and happiness in individual lives but also have subtle and far reaching implications on the society , as general quality of life is also affected by light pollution.

The human eye is equipped to naturally adjust to the day and night patterns so as to see in the right manner. Too much light, spillovers or glares can cause eye strain, loss of clear vision, aging of the eyes, and may damage human eyes and may harm the hormone melatonin which is responsible for regulating diurnal and nocturnal visions. This can result in sleep disorders and other health implications such as stress, exhaustion, headaches, increased anxiety, and some forms of obesity may develop. Some studies indicate a subtle connection between increased case of cancer and overexposure to light in terms of intensity and duration. The 4 June 2003 issue of the *Journal of the National Cancer Institute*, reported the outcome of study conducted on nurses who worked night shifts at least 3 times a month for 15 years or more and stated that they had a 35% increased risk of colorectal cancer.

Light pollution also interferes with crucial navigation systems for planes which may lead to accident. It costs lots of money to support the lighting of public places, homes, and commercial places. Huge amounts of money and loads of oil and non-renewable energy sources like coal are exploited to produce the ever needed power which leads to increased carbon footprint, energy wastage and upset ecological balances.

As lighting continue to create artificially illuminated environment and brightening of the skies at night, it has become increasingly difficult for sky enthusiasts to view the sky at night, particularly in urban areas. Astronomers too, have problems viewing and observing the activities in the outer space and sky because of the continued brightening of the skies by artificial lightings.

As a result of light pollution, the world is slowly losing the beautiful dark sky view with the moon and stars as well as other outer space objects. Many young people growing up in the city might never have the enthralling experience of viewing a beautiful starlit clear night sky. It is expected that, night lighting may have serious physiological consequences for humans, in addition to ecological and evolutionary implications for animal and plant populations, and may reshape entire ecosystems in future.

Recent Studies

The researchers have found that, over a seven year period, blue tits showed a real change in their reproduction while comparing behavior near streetlights with those without lights. It was found that, on an average, females near lights laid their eggs 1.5. days earlier than those in the dark, which may lead to a mismatch between the timings of peak food demand from their baby chicks and the peak timing of food that is available after hatchings. For the illuminated males of the blue tits, the success rates in pairings with females rose higher. While that may appear good for these males, the researchers caution that the male blue tits may get less sleep and be at higher risks of predation.

Future Course

Knowledge on the adverse effects of light pollution is still vague due to lesser studies in this field and difficulty in quantising various factors. In response to climate change and energy shortages, many countries, regions, and communities are developing new lighting programs and concepts with a strong focus on energy efficiency and greenhouse gas emissions. There is an urgent need for light pollution policies which would go beyond energy efficiency to include human well-being, the structure and functioning of ecosystems, and inter-related socioeconomic consequences.

Such a policy shift will require a sound transdisciplinary understanding of the significance of the night, and its loss, for humans and the natural systems. Knowledge is also urgently needed on suitable lighting technologies and concepts which are ecologically, socially, and economically sustainable. Untill and unless managing darkness or ensuring optimum duration of night without artificial lighting becomes an integral part of future conservation and lighting policies, future society may run into a global self-experiment with unpredictable and irreversible outcomes.

If future generations are to remember us with gratitude rather than comtempt, we must leave them more than the miracles of technology. We must leave them a glimpse of the world as it was in the beginning, not just after we got through with it.

-- Lyndon B. Johnson

References

- Anals of Annals of Applied Biology, scientists from the Leibniz-Institute of Freshwater Ecology.
- Hallmann, Caspar A., et al. “More than 75 percent decline over 27 years in total flying insect biomass in protected areas.” PloS one 12.10, 2017: e0185809.
- M. Grubisic, R.H.A. van Grunsven, C.C.M. Kyba, A. Manfrin, F. Hölker. Insect declines and agroecosystems: does light pollution matter? Annals of Applied Biology, 2018; DOI: 10.1111/aab.12440
- Forschungsverbund Berlin. (2018, June 19). Light pollution a reason for insect decline: Artificial lighting at night could be a reason for declining insect populations. Science Daily.
- http://cescos.fau.edu/observatory/lightpol.html
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627884/
- Retrieved June 25, 2018 from www.sciencedaily.com/releases/2018/06/180619122456.htm