

Light Pollution in Urban Life: Effects on Environment and Human Health

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Abstract:

Artificial lighting is indispensable for human activity. One thing that is not emphasized is the fact that it is the one that is responsible for the creation of light pollution. On the other hand, a significant amount of energy is wasted, and this pollution is clearly visible and thus, it has a disruptive effect on the nocturnal sky. Since numerous of these disastrous effects may be experienced, among these well-known are the death of birds flying over buildings illuminated by lights and the disorientation of hatchling sea turtles on natal beaches, the latter caused by light pollution. Little is understood about the severe consequences of these brightening levels on species behavior and even community ecology. Along with being to address the conservation issues, this is a novice area of ecology research. However, all of the risk factors are time-urgent and thus, there are feasible solutions to each of those risks.

Introduction:

Nature habitat recovery is now increasingly happening everywhere, near or in the natural areas, than ever before. It is the case that our natural environments are more and more exposed to the phenomenon of light fighting at night. When keeping the natural cycles of the sun, moon and stars, over-illumination or misuse of light and also their interference are all causes of light pollution. The side-effect of progress and civilization is the increased light pollution. It will also come from external building lighting, advertising, landscape lighting, offices, factories, street lamps, stadiums and other brightly illuminated areas. This matter, at last, has become a global issue, which leads to the slow fading of the clarity in our sky to look for the stars (Longcore and Rich, 2004). In support of good night lighting, it helps a lot in the completion of several commercial, industrial and leisure activities in different regions. Illegal installation or usage of light accessories leads to the death of various species and the pollution of nature. As per the Light pollution monitoring done by the International Dark Sky Association (ISDS, 2013), it has a lot of negative impacts on plant and animal species. Birds leave urban areas for the large distance between the night sky which is bright due to electricity and which is necessary for them to sleep. By artificial lighting, the situation of photosynthesis as a process of plants is also

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influenced, and so as the oxygen we inhale gets affected. The possibility, then, that the nightlight could lead to the disruption of homeostatic as well as behavioral control systems could portray a scary picture. Both national and local administrations, in equal measure, should be implementing the right action plan that will eliminate the negative effects of artificial lighting.

Astronomical and Ecological Light Pollution: Scale and Extent:

The fact that the brightness and its amount, which is artificial in nature, act as a first indicator for the size and development of modern human societies, providing that nighttime illumination has had an imperative role in the present civilizations (Hocker et al., 2010). It is important to note that, in this context, illumination refers to 'astronomical light pollution' in which stars and celestial bodies are glazed by forwarded or reflected light towards the point of the sky. The natural light-dark patterns that occur in the ecosystems are the ones disrupted by artificial light. Hence, ecologists refer to this as a case of persisting light pollution. Artificial light emissions can be seen as a phenomenon with probable consequences exhibiting a range of the GS+QS+ grade, including spatial and temporal scales, and its planetary reach can be observed from the first atlas of astronomical light pollution, which reports on light pollution on every continent where people inhabit (Cinzano, 2001). As regards wildlife, nocturnal lighting influences a lot of species, from plants.

Measurements and Units:

Building the denominator of ecological light pollution is the pathway of illumination determination. The illumination could be defined as the total quantity of light (be it sun light or manmade) that falls on a specific unit of area (Verheijen 1985). Measuring light usually depends on two properties of light: (i) spatial resolution, (ii) spectral resolution, and (iii) wavelength. Taken in day-to-day life, Lux (also known as foot candles - non-SI unit) is the most often applied unit to measure light in connection with the human notion of objective light characteristics. The illuminance coefficient, which is central to the lux measure, defines wavelengths of light that are the most visible to the human eye (Verheijen 1985). The human eye has been proven to adjust to different colors of light, and LUX is the standard that is commonly used by lighting designers, lighting engineers and environmental regulators. The elementary unit for observations and reporting in communications is the unit. Then, moths are used for a high-pressure sodium light but not for a low-tension sodium light. These lamps, which have the same Lux value, can only be compared to high-pressure sodium lamps since these are the only ones that are capable of emitting ultraviolet radiation. The moths are attracted to the presence of this particular type of radiation (Rydell and Baagøe, 1996).

Sources of Light Pollution:

Excessive lighting is a complex word that sums up a combination of issues, all of which are the result of ineffective, unattractive, or unnecessary use of artificial illumination. Sources of light pollution include urban sky glow, light trespass, glare and light clutter, of which the last two are mostly observed within urban areas.

Urban Sky Glow:

As a result of direct and indirect reflection, the night sky is brightening in urban areas in the context of scattering of light from the various components of the atmosphere (molecules, aerosols and particulates) (The Institution of Lighting Engineers, 2002). The very fact that we cannot even see stars, planets and the galaxy due to light pollution stands as enough to imply the magnitude of the problem at hand. The 'globe lanterns', often fixed to the facades or standing alone themselves, act as the base cause of the radiant glow that emerges from the sky. The astronomy stars get offended when the sky glow is high because they even fail to brighten the sky to the extent that they can only see the most visible stars. Almost all outstanding optical astronomical observatories are located within the area, the background of which are rules obligatory for observance. Luminous emissions, according to these rules, shall be strictly limited and be solely defined. Visualize 'sky glow' by employing luminaires that cast light only within 90 degrees measured from the horizon and above the horizon. It is especially a challenging 'indirect' way of sky glow that is produced by reflections from external vertical and horizontal surfaces. For that reason, the effective solution would be in its prevention with the minimization of over-illumination.

Light Trespass:

City lighting sometimes causes a problem known as Light Trespass, when the lights go into odd places. Just as the light bleeds into the wrong place when the lamp is not shielded. The election results are not the ones the voters would like to see. If a rule for this was approved, it would be set to control how much light spills over into the property line. The LEED protocol gives the allowance with the level set at, between lines, and 10 - 15 ft distant from the property perimeter or exceeding 0.01 foot-candles. Nevertheless, the beloved thing is the light trespass, but when it interacts with the eyes of people, we are not sure how much light enters in the eyes. This problem is in the way the cities solve it by enacting by-laws regarding how high a light pole can stand. Thus, controlling light is necessary. This implies the use of light that orients to the business purposes, putting them in the right places and paying attention to the overall level of light.

Over – illumination:

Over illumination, also known as the overuse of light, refers to situations where light is used beyond the recommended limits. Energy audits of existing buildings reveal lighting as the dominant ratio of its consumption, representing about 30 to 60 % at residential, commercial and

industrial levels across the USA, which varies by area of use (Fotios and Gibbons, 2018). Over-lighting can be explained via various reasons among which the most common is decorative. Unlike the others, the act of switching off lights when there is not anyone using them is all that is not done. Lighting layout mistakes can also be classified as picking the wrong faucets or light globes that do not illuminate where it is needed. One case that uses more energy for doing lighting work is selected hardware most of the time. This way is also tempting as building managers as well as occupants, do not get security education on the proper handling of lighting systems. Fortunately, the majority of these hindrances can be averted without expensive technology available. The problem needs to have immense particular attention being focused on them, especially from the developed nations, which will help in knowing the advantages of lessening over-illumination. The light can be filtered or other solutions can be used, reducing the direct effect of bright lights, although they will lead to less bright devices (Fotios and Gibbons, 2018).

Glare:

Glare is a visual sensation where there is a feeling of discomfort, decreased ability to recognize objects or eye irritation. It can be caused by improper distribution or range of luminance or excessive contrast. Even good-quality lighting fixtures can become problematic and cause Glare. The use of Unshielded or poorly located and directed luminaries near the line of sight may cause this phenomenon. The most effective ways to reduce Glare rely on the proper selection of lighting fixtures tailored to the project (Ibid et al., 1993).

Glare can be several types like-

Blinding Glare:

Blinding Glare describes effects such as that caused by staring into the sun. It is completely blinding and leaves temporary or permanent vision deficiencies.

Disability Glare:

Disability Glare describes effects such as being blinded by oncoming cars' light or light scattering in frogs or in the eye, reducing contrast as well as reflections from print and other dark areas that render them bright with a significant reduction in sight capabilities.

Discomfort Glare:

Discomfort Glare does not typically cause a dangerous situation in itself and is irritating at best. It can potentially cause fatigue if experienced over extended periods.

Light Clutter:

The clutter of light can be viewed as light clutter, which implies a profuse scattering of lights. Placements of light, be they non-consecutive or in sequence, may create disorientation, take eye attention away from obstacles and lead to falls as a result. The presence of clutter

could also suggest a potential risk in the activation zone if aviation lighting must provide proper conditions for the pilots' sighting and not be overlooked by the pilots. For example, these might happen with runways confusing commercial lights with suburban lighting or with aircraft collision avoidance lights having ground lights as a misperception (Fotios and Gibbons, 2018).

Effects

Impacts on Ecosystem and Wildlife:

Those ads are automatically put on silent, while those that are tagged "mute" are always on mute. Light pollution significantly disturbs their familiar night-time environment by providing night-time environment with the taste of the day. Nighttime light can also cause luminescence that tampers amphibian habitats, including frogs and toads, where the chorus of croaking at night time is part of the reproduction ritual. The presence of artificial lights meanwhile confuses this nocturnal event, which results in incomplete reproduction and decreases in the populations of animals involved. A lot of insects dazzle towards lights, but being artificial lights leads to a lethal crush. Some insects are also averse to some other species of plants depended for pollination or food or pollens. This includes herbivores attracted to beautiful plants that, other than acting as a visual treat to the eyes, become a source of nutrition to some predators who may, through such, exploit the situation in unanticipated ways, thereby affecting the food webs.

Impacts on Plants:

Functioning of plants includes but is not limited to managing their metabolism, their growth and development and their life cycle. What it can do to some plants is dramatic - to make them unable to blossom and bear colours ever if they are missing darkness for some time. Plant captures and reactions to light intensities influence the formation of plant foods, stem increases, leaf colour and flowering stipulations. Just like the above-mentioned example of two plants grown in very bright light, they end up being shorter, they have good branches, and their leaves are larger and dark green. The study finds that the ambient lights at night time may act in the same way as the photochrome hormone and high-going light levels avoid the release of the hormone and as a result, the plants are wiped out. Bidwell establishes that short-wave sodium lights affect the photoperiodic cycle and the growth pattern of plants (2003).

Impacts on Animals:

Periodic light and shadow structures have been here since the day the life existed, so aberrations to the patterns naturally affect various animal behavioural traits. Light pollution can directly stress the physiology of animals. Navigation, competitive behaviour, prey to predator relationship, and migration can be affected adversely due to the light pollution because of its specific effect on the creatures. Another critical aspect is that not only animals but also many insects are attracted by or repelled from the same lights. The overwhelming majority of animals have developed an eye remuneration involving diurnal or nocturnal light, which is disturbed if

the world is flooded with light. With this came a chance that an entire species could go towards extinction. It's the animals that really alter depending on the headway in the habitat where mainly they live. Over lighting may also attract pests to human areas. Pests may move by themselves when light is diminished in areas that are less polluted by light.

Threats to Birds:

Exhibit a vast repertoire of activity in response to the glare from artificial light in birds. Our studies revealed that bird behaviour is impacted by extremely bright lamps that are normally installed on oil rigs. This attracts them and forces them to move away from their migratory routes. Besides, these lights were capable of catching and killing more seabird fledglings with a high death rate. A correlation exists among birds whereby during nighttime illumination, they alter their behaviour at rest. This sunlight can make a bird awake sooner, which may lead to a loss of sleep episodes or they will be inactive for long. In Lighthouses, it was pointed out that whether there would be a lot of deaths is determined by the sort of light being used. People would be more inclined to employ white lights that are mounted in the usual manner than flashing or colored lights. Along the flight path, the beam of the laser could decrease the pilot's ability to steer as much as three meters per second and also alter its flying direction by up to 15%. The lamps on the platform attract birds, which can be lifelong injured or even die of heat scalding or oil collision indeed. Finally, flares on the windmills can be used to divert birds as well. The statistics show that there has been an increase from graph to graph in the number of total collisions between wild birds and broadcasting and telecommunication systems' towers, both in terms of concerned towers number and height. On other hand, songbirds could bear on their wings as well instead of the highway that has divided their path of migration. The continuous growth of cities and thus the ever-increasing number of artificial lights, for example, street lights and buildings illuminated, change the environment of migratory birds and may cause birds deaths as a result.

Threats to sea turtles:

Concerning the effect of artificial light on female turtles in terms of nesting, and on the hatchlings under the water after their arrival, we can summarize that there are a number of effects. The fact that the females choose to lay at more dimly lit beaches means that their nests become scattered around these places and not lighted areas with more light. Turtles can be drawn to the sources of urban lighting, such as car parks, roads, and houses. It follows that their movements will be in the opposite direction of the light in such situations. This light effect can not only influence the sea turtles' hatch but also the illumination direction. The bizarre light is more often than not misread as a signal to the wildly hatched sea turtles to go to water for the purpose of their endeavours. As a consequence of this, the hatchlings will crawl in a way that is contrary to what safe and the right connections are, hence risking getting dehydrated actually getting preyed, and high day temperatures after the break of day (Salmon, 2003). Compasses

point them towards the sea but can do so only if specific strength and light intensity regulations are met. Thus, hatchlings may lose their bearings and head inland, where they will never reach the sea and, inevitably, die.

Threats to Fish:

The artificial lighting in input to fish farms and deep sea fish has an impact on visibility, and the reaction to the natural light by fish is very specific while the species difference exists. The fish are nonchalantly attracted to the light in the dark by anglers, so light attraction is a usual method for them. This method poses a high risk of seething in infant silver cyprinid fish Mukene (*Rastrineobola argentea*), Nile perch, and Tilapia hence killing their nursery grounds. The white light application represented as the primary obstacle that altered fish behavior in natural dialects when studied in depth-sea fish lighting machinery. The depth of the aquaculture and the number of activities of swimming are dependent on how much light is used in the farms whether it is too less or too much. Salmon hold their schooling behavior firmly just as they are said to take the graded position near the artificial light just as Parido et al. (2001) did reveals.

Threats to Molluscan Species:

In addition to molluscs light seems to have a role in their behavior - that is, they substantially avoid predators and that in turn it 'light' is responsible for snails to be attracted. Through launching deep into one's whole body the immune response that *L. stagnalis* uses, it manages to live after the exposure to predators. Also in mollusks' reproductivity could be affected by interference created by pollution or their growth and development. In the freshwater pulmonate *L. stagnalis*, the organism is able to achieve a rapid rate of growth together with increased energy storage when it is exposed to a source of light on a regular basis. Salmon and Wyneken (2003) found that the quantity of energy being saved by medium-day snails was more than that being used by long-day snails and vice versa.

There is mention of the varieties of mollusca species too as they are light sensitive. *Aplysia californica* sea slug breeding is somewhat insensitive to shifts in daytime/nighttime proportions unlike to the snails that live in the freshwater. The development and growth of gonads which is the another reproductive parameter is also by the light considerably affected. Earlier Sokolove and McCone (1978) found that the gonads and the oocytes of native *Limax valentianus* slugs which had been placed under short photoperiod were heavier than those of slugs that had been placed under a long photoperiod. This being the unique situation was the first time it was seen. Write an appropriate response to this post question. Instructions: Humanize the given sentence. The distinct difference evolved as a re-emergence of it exactly after hatching the egg and gaining the cycle up to 90 days, and it would seemingly disappear once reaching 120 days, whereas the latter one underwent the same way, short photoperiod slugs, of reaching the final stage of spermatogenesis (Jess and Marks, 1998).

Effects on Human-health and psychology:

It is interesting to see the conclusions from the recent medical research on how excess light affects human bodies, as it seems that light pollution may cause a range of sicknesses and disorders that are injurious to the health of human beings. Medical professionals can diagnose an increase in the number of headaches, tiredness, and stress, as well as an act of decreasing sexual function and an increase in anxiety as the result of excessive artificial lighting considering the wrong spectrum of light. To be exact, for those who have to attend night shifts, in addition to the light what is in the atmosphere during the night also changes your mood and impacts you significantly.

Glaring in the eyes:

A type of disability is called visual impairment that leads to crosslights which is not due to intentional design of the street lighting. The conceiving truth is that the glare emitted by disability is blinding dark like an oncoming vehicle leaving you to open your eyes in the haze of sunlight currently being scattered all over your retina. The levels of light in such a situation, with the sole exclusion of the source of the light, are inclined to when the rest of the objects fail to become visible. The fact that our eyes already have problems with adjusting to varying levels of illumination and in older age especially the condition worsens even more with glare vision disability being the end result. Drivers are exposed to a relatively lesser amount of hazard with protected illumination that is accomplished by this occurrence and driving becomes safer and more enjoyable as such. The light projection will be done more expansively and the light will eventually be directed to the road rather than the eyes of the drivers.

Changes in the circadian rhythm:

This is a 24-hour cycle of day to night, which is popularly known as, the circadian clock, that has a significant effect on the physiological processes in every organism including human beings. The brain is a complex organ that works in conjunction with the patterns of brain waves, the generation of hormones, the control of cell activity and other biochemical as well as physiological functions. This disruption in rhythm could result in the appearance of different health issues such as cardiovascular disease, sleeplessness, cancer and depression. It appears that, in particular, women taking on night shifts, have an increased possibility occurs developing breast cancer. The cells were exposed to intensive night lights and this was linked to the growth of breast tumors in the test, as shown by the laboratory experiment. To the extent of being a direct link between the intensity of the light coming from the room which has shorter wavelength (less than 46nm), the risk of breast cancer is almost entirely dependent on its intensity. This, hence, it establishes that those women at home are as vulnerable as the ones in the active fields of life to the potential risk of breast cancer. The use of contraceptives with quartz stones was particularly to blame for this. In industrialized nations (such as Canada and United States), the risk of breast cancer was up to five times higher than in poor nations.

Changes of Melatonin Level:

Melatonin is an endocrine hormone responsible for the regulation of the maintaining the state of sleepiness and darkness is its major triggering factor. Teams producing melatonin is the case of hormones available to us. Melatonin is an agent in the body responsible for various biological reactions which all have an effect of decreasing estrogen levels throughout the night. Melatonin is often formed by the body at night, and the level of melatonin diminishes to almost zero due to the fact that the body is exposed to external light (artificial or natural) (Madhu and Manna, 2010; Madhu et al., 2010; Madhu and Manna, 2011; Madhu and Manna, 2021 Melatonin which is mostly produced at the night time has been linked with the studies that may be indicative of the population going to be more vulnerable to cancer if the melatonin levels are reduced. However, response to melatonin treatment was also dramatically decreased in a patient after the influence of breast cancer. Though this wasn't the obvious causal event, there was a clear correlation between the quantity of melatonin in the body and the development of cancers in the colon, larynx, liver, and lungs. According to a research report, communities with whom high-levels of exposure to artificial light during the nighttime hours were more likely to develop prostate cancer in contrast to those with low levels of exposure. We placed these two groups of participants under conditions of similar sleep routines with a low level of exposure to light pollution. Melatonin is mainly hydrolyzed in men with 6-oxo hydroxy melatonin-sulfate (6-SOHMS), a degradation product, having a lower risk of developing 75% prostate cancer according to the investigation conducted in Iceland (Sigurdardottir et al., 2015). In relation to this, it is obvious that the experiment had proven the prediction previously made by the researchers.

Sleep Disorder:

Although adequate sleep is fundamental for mental and physical states, most of us realise that the bed soothing conditions in the darkness are conducive to that. Disruption of proper sleep rhythm is one of the most severe challenges that suffer from these people. It may happen that chip of a chip as people can have trouble sleeping underneath their new solar-like surroundings. As a result, it may have a bad impact on their health which can be the reason for a lot of diseases. An abrogation of our inside rhythm of time lessens our motor and cognitive capacity even in the most effortless tasks for us and also makes it difficult to go to bed and wake up at the usual time, declares NIH. The association of the factors with better sleep is decreased risks of depression, stress, weight gain, and diabetes. It is likely that the very obvious link that exists between switch-on to artificial light and different sleep problems would definitely exist. Numerous sleep disorders may result from the clock's circadian function troubles. Thus, desynchronization of the circadian rhythm, e.g., shift-work sleep disorder, which is experienced by professionals who are active at night or whose duty times are unconventional. In turn, the delayed sleep-phase syndrome is characterized by people who fall asleep late and have problems waking up on the dot for class, a social event, or work

(International Agency for Research on Cancer, 201) Temperature oscillations, desynchronizing of the biological clock that is measured by 24-hour periods conforming to sunlight, resetting the hypothalamic pacemaker, exhibiting repeated headaches, fatigue at work, stress-related symptoms (according to the criteria of a doctor), lowering the sexual function, and increased anxiety as well are some of the possible health effects of improper spectral proportion of lighting.

Effects on Astronomy:

Light pollution greatly affects astronomy. Because the sky glow makes it harder to see fainter objects, it makes it harder to distinguish between the sky and celestial objects like galaxies. This is one reason why newer telescopes are being constructed in more and more inaccessible locations. The Bortle scale measures the likelihood of spotting an item in the night sky. Light pollution has a greater impact on the sight of diffuse sky objects like nebulae and galaxies than on stars, because of their lower surface brightness. Finding the Milky Way is a quick and easy way to gauge the amount of darkness in a given area. In addition to sky glow, light trespass occurs when non-optical surfaces reflect artificial light into the telescope tube, which in turn affects observations (National Geographic, 2008).

Effects on Economy:

A waste of resources is the massive illumination of pointless spaces by artificial lighting. The environmental and economic costs of energy waste are high. According to Ashe et al. (2010), a staggering 35 billion kilowatt hours of electricity are wasted each year for outdoor lighting, amounting to USD 35 billion. This is because 30% of outdoor lighting is not adequately lighted. Compared to low-pressure sodium lamps, incandescent lights use five times as much energy, while fluorescent lights use one and a half times as much energy. This proves beyond a reasonable doubt that light pollution is a major economic sustainability risk element in addition to a danger to public health, ecological balance, and astronomical study.

Ways to Reduce Light Pollution:

Bringing down the amount of light pollution involves a number of different elements, including lowering the amount of sky glow, glare, light trespass, and clutter. One potential remedy is to reduce the amount of harm that is caused to the environment, as well as to the flora, wildlife, and people. It is essential to regulate the total level of lighting in accordance with the number of people present and the time of day. Therefore, it is essential to make use of light sources that have the least amount of intensity in order to achieve the objective of the light. The utilization of a lighting control system that is both flexible and equipped with an astronomical time clock facility as a means of ensuring that the appropriate illumination is provided at the appropriate location and at the appropriate time is recommended. Improving lighting fixtures so that they focus their light more effectively towards where it is needed and

with fewer side effects; turning off lights manually or using a timer or occupancy sensor when they are not needed; Improving lighting fixtures.

Lighting Control:

It is vital to adjust the general amount of illumination according to occupancy and the time of day in order to limit the harmful impact that it has on the environment, as well as on flora, wildlife, and people. It is recommended to utilize a lighting control system that is both flexible and equipped with an astronomical time clock facility. This system should be able to ensure that the appropriate amount of illumination is provided at the appropriate time and location. Not only does this make use of location data like latitude and longitude, but it also features a mechanism that allows the date and time of the year to be updated. Additionally, it activates and disables the external illumination based on the information that it receives. The degree of light intensity should be reduced or turned to "0" after the peak activity period, which is around midnight or another time that has been specified. This will allow for a significant reduction in the potential adverse effects that could be caused to the urban environment. In addition, daylight sensors should be utilized in buildings that are made of glass in order to maximize the amount of natural light that is produced for as long as possible while simultaneously reducing the amount of energy that is required for electrical lighting (Burkett, 2013).

Conclusion:

Having finished the investigation of the lighting master plans practiced by the cities and by the author for the practical design experience, it is clear that the only possible way to overcome the drawbacks of light pollution for the cities will be to call upon professional independent lighting designers and city representatives that will define the lighting level in the city at the macro level for the lighting master plan that will make it possible. Light pollution is a severe problem carrying with it repercussions for the animal kingdom, human well-being, scientific study, energy consumption, climate change as well as a youthful activity that goes far back to the dawn of time; that is, to watch the night sky. Light pollution is a threat not only to astronomy across the world and public health ecosystem balance but also to the economy, which makes the danger exerted on the concept of sustainability quite urgent. Installing documents of the type a set of guidelines turns out to be helpful for those people who are responsible for the illumination of the cities at night and would give them an idea on how to solve challenging issues.

In order to achieve success at the macro-lighting level, it is necessary to have electrical light sources that have a long lifespan, in addition to having a suitable color temperature, luminaries that have optics that match the requirements, easy maintenance, installation, and a high mounting position. The utilization of an ecological and holistic approach, in conjunction with the replacement of lighting sources that are inefficient and ineffective, reduces the amount of light spill and energy waste, assures the protection and strength of the environment, maintains biodiversity, reduces air pollution, and conserves resources. Creating an effective luminaire to

light up indoors requires a great development process. The critical issue here is not only choosing the optimal place of the light source by taking into account both its quality and quantity but also balancing it with the conflicting criteria. Clarification studies still need to investigate the relationship between self-reported subjective everyday levels of light at night and actually assessed objectively in order to reproduce the current findings precisely and to incorporate additional factors into the multifactorial equation.

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