

# Light Pollution and its Effect on the Living World

Edit PINTÉRNÉ NAGY

Institute of Forest-and Wood Protection, University of West Hungary Faculty of Forestry, Sopron, Hungary  
epinter@emk.nyme.hu, H-9400 Sopron, Bajcsy Zs. Str. 4.

**Abstract** – The paper reports on the effects of artificial light. Light pollution is an increasing urbanization problem at the present time. Every kind of light which is made by humans, and gets to the place not intended and planned, in particular the light that is directed towards the level of the horizon, is light pollution. At first it was the astronomers who paid attention to its negative effect on the environment, and have proved it many examinations. The poster shows the effects of the artificial light to the starry sky, humans and animals. In many countries the background light of the starry sky has grown ten times more and therefore the stars visible to the naked eye have decreased. Migrating birds who orientate with stars, could lose their ways because of the increased background light of the sky. Light pollution has an adverse effect on some mammals, reptiles, insects also.

**Keywords:** light / pollution / artificial /sky

## 1. INTRODUCTION

Due to the development of the human society and technique, more and more huge cities can be found all over the world. In cities and inhabited areas overnight illumination is significant because of several reasons. To the modern townscape the evocative night-light also belongs, increases the safety-feeling of people and it is indispensable from the point of view of traffic. Unfortunately the measure of public lighting very often exceeds the needed values. This may have an interfering effect on humans and animals, among others.

## 2. THE NOTION OF LIGHT POLLUTION

### 2.1. Light pollution

When talking about light pollution we mean the change of natural overnight lighting by human activities. Every kind of light created by humans that reaches a point, it was not meant to, can be considered as light polluting. This is also true in the case of lightbeams, which direct over the level of the horizon. Consequently during the past 2 or 3 years the background illumination of the sky has increased with ten times more (NOWINSZKY 2007). Light pollution is a relatively new phenomenon in the circle of environmental damage. There are three main types of it: astronomical, ecological and polarized.

#### 2.2.1 *Astronomical Light Pollution*

It was the astronomers who turned their attention to light pollution and the harmful effect of limitless lighting for the first time. Disturbing lights from luminous sources made it almost impossible to accomplish astronomical research, since they were manifold more intensive than the natural background lighting. The number of stars visible to the naked eye, it means 4-7 thousand stars on the average, has decreased dramatically. Due to the exponential increase

of artificial light quantity, Milky Way will have disappeared in most parts of Europe by 2025. Researchers talk about light pollution when the artificial lighting reaches 10 % of the natural background lighting. This value has been given by astronomers. Cinzano and his colleagues have created a background-lighting map with one kilometer breaking down, in which Budapest and its surrounding can be seen as a definite reddish spot. Here the overnight sky is nine times lighter than natural lighting in bright weather around the zenith (KOLLÁTH 2004)

### **2.2.2. Ecological Light Pollution**

Overnight darkness probably plays a significant role in the human body. Overnight light blocks the formation of melatonin, which is a strong anti-oxidant hormone, the reduced concentration of which not only does help the growth of different tumors but also influences the operation of the immune system and metabolism. Women working in several shifts, at least three night shifts within a month, suffer from mammary cancer and intestinal cancer more often than women working in day-shifts (SZOMRÁKI 2007). Luminous intensity basically determines the decisions, behaviour and the direction of migration of animals, even if they have to find the place of food sources or the area of reproduction. Researchers have studied that light pollution causes several negative effects in the life of birds. When migrating, some bird species use stars as orientation base during the night. If the stars grow dim, due to the increased background lighting and cannot be seen, the birds may lose their way. Light pollution can also cause escaping reaction. This means that bird species choose their nesting places very far from the illuminated institutions, even if their habitats have not changed at all. By doing so their living space not only does decrease but also the distance between the area of nutrient needs and the nest or the den increases.

This means that they have to fly more in order to get their food. Artificial lights also affect the biorhythm of birds species. Certain species sing all night (e.g. *Turdus merula*) becoming troubled by light pollution. Other birds start their nesting weeks earlier since artificial light lengthens days and shortens nights (SZABÓNÉ 2004). If daylight lasts longer, there is more time for nourishment, and this kind of change has totally transformed the birds' migrating habits. Speciment of one of the populations of a wintering little swan (*Cygnus columbianus*) in England very quickly accumulate fat reserves needed for their long migration and this is why they start to fly for Siberia sooner than before (VERLYN 2008). Lights of high, illuminated towers bother birds, and of course they cannot bang against stars but can against towers lit by artificial light (SZOMRÁKI 2007). Mass of flying insects around street lamps attracts bats as well. The individuals of the population of a certain European bat (*Rhinolophus hipposideros*) species dramatically decreased in some places in a valley of Switzerland because they put strong-light lamps into action. Mini-bats (*Pipistrellus pipistrellus*) soon realized that insects gathering around streetlamps provide permanent and rich meal, and due to this, their number increased and they pushed out the European bat from their habitat. Artificial lighting impacts flying activities in the case of certain bat species and consequently this causes severe in ontogeny. Some research was made with bats living in different buildings and they found that the activity to fly out was totally different for buildings illuminated and not illuminated. From habitats not disturbed with lighting, bats were leaving 30 minutes after twilight, while at illuminated places the most of the bats stayed until switching off reflectors. According to observations the length and volume of the bats' forearm is less in illuminated buildings. The reason is that lighting postpones the timing of bats' flying out, which results in the shortening of hunting time on one hand, and the loss of the most favourable hunting season on the other (at twilight the density of insects' specimens is particularly large) (BOLDOGH-DOBROSI-SAMU 2007). Artificial light causes a lot of trouble for insects, too. Light sources lure night-flying insect species from their natural habitats and feeding places. They provide

rich food for predators so insects may directly or indirectly die, even the total destruction of a population may occur. The luring effect of the light source depends on the height of the source, its capacity and the spectrum of the released light. Insects gathered around street lamps count as easy prey for birds and frogs, which might result in a deterioration that cannot be renewed any longer. Insects regard light sources as navigation points, and many are swept away because of headlights of vehicles or streetlamps. They either die under the lamp cover or because they get exhausted to fly continuously towards the given light. The population of big fireflies (*Lampyrus noctiluca*) has decreased very much until now, due to the increased light pollution. The light-signs of the female species are extremely important in the course of reproduction, though due to light pollution they become disturbed, do not find one another, consequently the trial to reproduce ends in failure (VERLYN 2008). Sea turtles (*Chelonoidea*) in Florida, where they have their biggest hatching area, creep forth from under the eggs in the protection of latenight darkness and creep on the sea. The direction of the sea is defined by the starlight reflecting the surface of water or by the moonlight. Due to the impact of artificial lights the turtles start for the wrong direction not for the water but for the land, which leads to their death (KOLLÁTH 2002).

### ***2.2.3. Polarized Light Pollution***

When examining the ecological effects of light, researchers realized that not only the strength of light but also its polarization is a very important factor in the life of living creatures. Hungarian and American researchers have described it for the very first time that the so-called linear polarized light, which reflects light from different artificial surfaces and is not perceptible for human eyes, has some deceptive information for a number of animal species. This not only deviates in its spatial but also time-relating occurrence from the traditional ecological light pollution. This is because the latter may occur only at night and the former in any period of daytime. This phenomenon is called polarized light pollution, which is a new sort of type of environmental damage. Polarized light pollution means the harmful effects on animals, sensitive to polarization and on polarotactic aquatic insects (*Nepomorpha*) in case the strongly and horizontally polarized light is reflected from smooth (illuminated) surface (MALIK-HORVÁTH-KRISKA-BRUCE 2008). More than 300 insect species look for habitat in water with the help of positive polarotaxis. These polarotactic insects can easily be cheated and lured by every artificial surface, which reflects strongly and horizontally polarized light. Such surfaces seem to be “super water” for aquatic insects seeking water if the linear polarization degree of light reflected from them is bigger than of from water. The strongly and horizontally polarizing artificial surfaces might be polarized ecological traps for ovipositing aquatic insects. The reason is that the ova of the lured polarotactic insects put on surfaces fall into ruin. In natural optical environment it is only the smooth water surface that reflects strongly and horizontally polarized light in bigger optic angle. Polarized light pollution spreads all over the world and is brand new in terms of evolution since it increased only in the past few decades following the number of artificial surfaces (e.g. open oilspot, asphalt roads, plastic foils, glass panes, car-bodies) which are strongly and horizontally polarized. The harmful effect of polarized light pollution may strengthen together with the traditional (caused by phototaxis) light pollution. Researchers have observed that dragon-flies, for example, behave at polarized light polluting sources just like at water surfaces: patrolling flight, protection of territory, touch of water, prey-catching in the air (HORVÁTH -MALIK 2009).

### 3. REGULATION OF LIGHT POLLUTION, CHANCES OF ITS DECREASE

In Hungary legal regulation in relation to light pollution started in the village called Dág for the first time. Regulation refers to the setting of street lamps, their placing, the quality of luminous bodies and the duration of lighting. The regulation of Dág also mentions the future formation of light sources to be installed, the operating time of lamps used for sport activities and entertainment and the layout of lamps used for the floodlight of public places, monuments and gardens. The regulation bans the operation of screens and lasers for advertising, entertaining and cultural activities. Light pollution may be decreased if the light is directed downwards and we minimize the upward lighting by using glass shades and shading shields. We should not direct light beams over the plains of the horizon (SZABÓNÉ 2004). Polarized light pollution may be avoided, if in agriculture we use white foil instead of black or we paint our car white instead of black. We should decrease the building-in of glass panes to the minimum, furthermore, we should turn smooth and light surfaced asphalt roads into a rough surfaced one (HORVÁTH -MALIK 2009).

### 4. SUMMARY

The world around us is threatened by a new type of environmental damage. This is caused by us, humans, by neglecting our safety and comfort even not thinking of the consequences. We can differentiate various types of light pollution: astronomical, ecological and polarized light pollution. The use of exaggerated light sources and their harmful timing disturbs astronomical observations. It is of damaging impact to the human body, it effects the orientation of bird species in a negative way, and also bothers the flying out of bats and their ontogeny. For insects flying overnight, artificial lights mean a serious risk, since strong lights lure them from their natural habitats. In the poster I am displaying a relatively new form of light pollution i.e. the polarized light pollution which, together with the traditional light pollution, can put its harmful strength even more vigorously. Besides I am mentioning the regulation of light pollution and, with an example, I am talking about a possible decrease of the effects of light pollution as well.

### References

- BOLDOGH, S. - DOBROSI, D. - SAMU, P (2007): Szállásépületek kivilágításának hatása a denevérállományokra. VI. Magyar Denevérvédelmi Konferencia, Mártély 2007. október 12-14. V. és VI. Magyar Denevérvédelmi Konferencia Kiadványa [Effect of the illumination of buildings on bat colonies. Proceedings of the 5th and 6th Conference on the Bat Conservation in Hungary Mártély. October 2007.] p. 98-102.
- HORVÁTH, G. - MALIK, P.(2009): Poláros fényszennyezés. [Polarized light pollution.] Környezetfizikai Módszerek Laboratóriumi Gyakorlat ELTE. 2-13p [Environmentphysical Methods Laboratory Training] ELTE 2-13. p Budapest
- KOLLÁTH, Z (2002): Polaris csillagvizsgáló: Mi is az a fényszennyezés? [Polaris observatory: what is the light pollution?] (<http://polaris.mcse.hu>)
- KOLLÁTH, Z (2004): Fényszennyezés és világítástechnika [Light pollution and lighting technology] (<http://fenyszennyezés.csillagaszat.hu>)
- MALIK, P. - HORVÁTH, G. - KRISKA, GY. - BRUCE, R.(2008): Poláros fényszennyezés. [Polarized Light Pollution] Fizikai szemle [Physical Review] 11.: 379-386 p.
- NOWINSZKY, L.(2007): A Jermy típusú fénycsapda gyűjtési távolsága fényszennyezett környezetben [The distance of the collection of Jermy type light-trap in light-pollutioned environment.] Növényvédelem [Plant Protection] 43 (1): 31 p.
- SZABÓNÉ, ANDRÁSI ZS.(2004): A fényszennyezés szabályozásának lehetőségei. TDK dolgozat [Chances of regulation of light pollution. ]TDK dolgozat [Scholarly Work] Szeged. 28-32 p.

SZOMRÁKI, P.(2007): Fényszennyezés-zajszennyezés. [Light pollution-Noise pollution] Diplomamunka [Diploma Work] Budapest p.15.

VERLYN, K.(2008): Haldokló sötétség. [Dying darkness] National Geographic 6(11) :November 88-109 p.