

Light Pollution and Shorelines

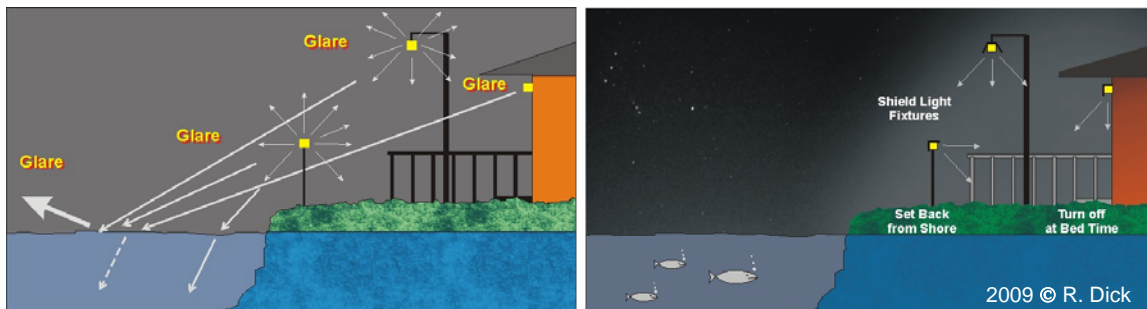
Historically, waterways have been used for transportation and recreation. However, they are also important ecosystems that support wildlife in the water and on the lands adjacent to the shoreline. Shoreline property is valued by our society and this is causing human developments along rivers and around lakes. An increasing number of properties have shoreline lighting that illuminates the waterway. This impacts the river and lakes in two ways.

From the human stand point; bright lights along the shoreline make it very difficult to navigate the channel. Glare from unshielded shoreline lighting prevents our eyes from becoming adapted to the darkness. At night, a boater will only be able to see the points of light along the shore rendering the channel markers and out-of-channel hazards very difficult to see. Clearly, glare along the shoreline results in a safety hazard that should be corrected.

The second impact is on the fish and aquatic plants¹. The effect of light on fish is not clear. Fish are attracted to the light from their natural feeding depths. The increase in the concentration of fish changes the hunting efficiency of predators. Although the behaviour of the nocturnal predator may not be compromised by artificial light, the ability of its prey to recognize the danger and to escape will affect their survival.

Zooplankton is near the bottom the aquatic food chain. They are quite vulnerable so they tend to stay deep during the day and surface during the night to feed. Their cue to rise from the depths is darkness. Shoreline lighting and even sky glow from a nearby city will deter this vertical migration. The zooplankton that does surface are easy prey for other animals because they are more easily seen in the illuminated water.

Artificial light that shines out over the water reflects off the surface to produce the glare for boaters, and homeowners across the waterway. But wave action ensures that perhaps half the light hits the water surface at greater than the critical angle for reflection, and penetrates the water. So artificial lighting will impact more than the narrow and shallow shoreline.



¹ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006, Part V

Light Pollution and Animal Behaviour

Although many people are familiar with the activity of the natural world during the day (i.e., photobiology), few people are as familiar with similar activity at night. Humans are not the only species whose biological clock is controlled by day-night contrasts and the release of melatonin. It is found in plants and animals wherein it plays a similar role¹. Wildlife depends on the darkness of the night and the study of this dependence is called “scotobiology”.

Research into the nocturnal environment is relatively recent compared to research into the daytime environment. Consequently there is far less published literature documenting the sensitivity of the general nighttime ecology to artificial lighting. Most of the research is on specific species in the wild or laboratory studies. However, mounting scientific evidence is documenting the profound impact of artificial light on the ecology of the night.

Plants are affected by the colour and duration of lighting. Whether the effects are considered beneficial or not depends on the desired outcome. Generally, artificial lighting will change the natural growth patterns and may affect the resistance of plants to infestations and disease. Many plants respond to the length of the night and normally recognize it as an indication of the season. By extending light past the evening, may slow the plant’s biochemistry from changing to prepare for winter². The various affects of colour, duration, type of plant, etc. makes sweeping conclusions impossible however, they indicate that changing the lighting environment will alter the natural ecology of the area.

Artificial sky glow extends well beyond the city boundaries. Therefore in considering urban outdoor lighting, we must also consider its impact on rural areas in the region.

Exposure to short periods of bright illumination (less than a minute) does not seem to affect the biological rhythm in animals³. However, longer exposures to light can shift (or entrain) their circadian rhythm and modify their behavioural patterns. Minimizing the duration of exposure to artificial light is necessary to limit its impact.

Seasonal variations will shift the time of sunset by over four hours (from roughly 16:30 in winter to 21:00 in summer – in mid latitudes). During the peak of Park activities in summer, the time of sunset can vary by two hours. In addition to this, dusk can extend the daylight by as much as an hour. Although no references were found in the published literature that documents how wildlife accommodates for this variation, their behaviour has presumably adapted to it.

¹ “Lighting for the Human Circadian Clock”, S. M. Pauley, *Medical Hypotheses* (2004) 63,588–596

² *Ecological Consequences of Artificial Night Lighting*, C. Rich, T. Longcore, Island Press, 2006, Pg. 405

³ *Ecological Consequences of Artificial Night Lighting*, C. Rich, T. Longcore, Island Press, 2006, Pg. 24

Artificial lighting changes the nighttime behaviour of various species⁴. Over a month, the changing phases of the Moon affect the ground illumination at night. Nocturnal mammals adapt their behaviour over the month in sympathy to moonlight to avoid predators. This behaviour includes, in part, limiting the foraging area and carrying food back to their shelters instead of eating it in the field. This latter adaptation limits how much they can eat⁵. They compensate for this during the dark time of the month.

Predator and prey behaviour depends on the darkness of the night⁶. Illumination levels that significantly affect wildlife are believed to be at the level of the full Moon, although the effect begins to be evident at lower light levels⁷. To put this in context, it is generally recommended by the IESNA that an urban parking lot be lighted to more than 100X this level.

It is well documented that some insects are drawn towards light sources. This interrupts their normal mating and foraging activities and it concentrates them within a small area thus enhancing predation⁸. They may swarm the light fixture until they fall to the ground exhausted. The resulting pile of insects must then be cleaned up.

Animals separated from their normal foraging grounds by an illuminated road cannot see the area beyond the lights. Even the occasional passing car can temporarily blind them with headlights. Their natural instinct is to wait until they can see where they are going. This can leave them in the open and vulnerable to predation. They may cause them to abandon their established foraging patterns for new ones, which will impact other species as they compete for resources⁹.

⁴ The Urban Wildlands Group (www.urbanwildlands.org/abstracts.html)

⁵ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006, Pg. 28

⁶ *ibid.*, Chapter 2

⁷ *ibid.*, Chapter 11

⁸ *ibid.*, Chapter 13

⁹ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006

Light Pollution in Rural Areas

by Robert Dick (dick@starlight-theatre.ca)

Light pollution is excessive illumination that extends beyond where it is needed or wanted and it can be more than just a nuisance for neighbours. Light pollution is a relatively new form of environmental contamination that was first recognized by astronomers in the 1970's and is now widely recognized for its impact on the environment and human health. It changes the wildlife habitat and it can even impact our physical and emotional health. This article will raise your awareness of light pollution. It will also suggest simple ways to minimize its effect on our environment.

Outdoor lighting has been driven by cheap energy and a fear of the night. Energy is no longer cheap and much of this fear is misplaced. We illuminate our grounds for security and to show off our property. With our property on display throughout the night, vandals and thieves can freely do their evil deeds without being encumbered by a flashlight. With the property owner and neighbours asleep, no one will raise an alarm until the morning when it is too late. Light is only useful when there are people around to see it.

In catering to this fear, we are inadvertently contaminating the natural environment. If we are to be good stewards of the land and water, we must understand that even light can be dangerous. But unlike air and water pollution, light pollution is easily reduced.

Nocturnal Lighting and Health

Our active daily lives result in physical damage to our skin, muscle and other tissues that must be repaired. The scheduling of these repairs is governed by our internal body clock – the circadian rhythm that is kept in sync with our daylight activity by detecting the day-night contrast in lighting.

Our bodies enforce this repair by releasing the hormone melatonin into our blood and putting us to sleep. It takes about 3 hours for most of this work to be completed - longer if we have more extensive damage. The best time for these repairs is in the early part of the night. My grandmother used to say that the hours of sleep before midnight were the most beneficial. She seems to have been right. If repairs are delayed by artificial lighting they may not be completed.

Our minds also require a bit of a clean up. Think of your desk at work at the end of a busy day. Papers and notes are scattered about. These have to be organized and filed so they can be easily found the next day. Without this re-organization – we would have a very confused work world. It is the same with our minds. Our daily memories have to be compressed and filed so they can be quickly recalled when needed. This also requires sleep in a darkened room.

Wildlife



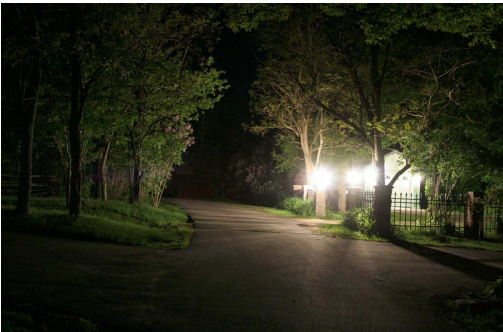
Contamination from Single

Scotobiology is the study of the ecological dependence on darkness. There are many nocturnal creatures that are most active during the night that forage for food with less fear of predators. A single yard light can contaminate over one square kilometre. To avoid the danger of the artificial lighting, wildlife may change their behaviour by foraging less or abandoning their familiar habitat. As they migrate into other areas, they put pressure on the indigenous wildlife as they compete for limited resources.

Under the bright full moon animals reduce their food intake but for the rest of the month during the relative darkness, the affected animals compensate by eating more. However, with artificial lighting, there is no dark time.

Songbirds rely on a good insect population but a single light will attract insects from over 100 meters away. This interrupts their normal behaviour of eating, mating and migrating. As they decrease in number, the insect-eating birds migrate to other regions in search of a better food supply. The apparent loss of songbirds has been attributed to these changes in their environment.

Vegetation is also affected by artificial light. Some plants get their cues about the season from the length of the night. A short night means it is late spring and time to pollinate. Nights that are getting longer indicate it is time to store up nutrients and drop leaves in preparation for winter. Artificial lighting keeps the nights short and “summer-like” delaying pollination until it is too late for the insects and delaying the preparation for winter until it maybe too late.



½ kw of Private Marker Lighting

Examples of light pollution are not limited to hamlets and towns. They are found across the rural landscape. The main source is uncontained private lighting from “dusk-to-dawn” yard fixtures, driveways and outdoor building lights. Many of these are left on even after the occupants have gone to bed. Not only do they make it difficult to see along a country road but they contaminate the area for wildlife.

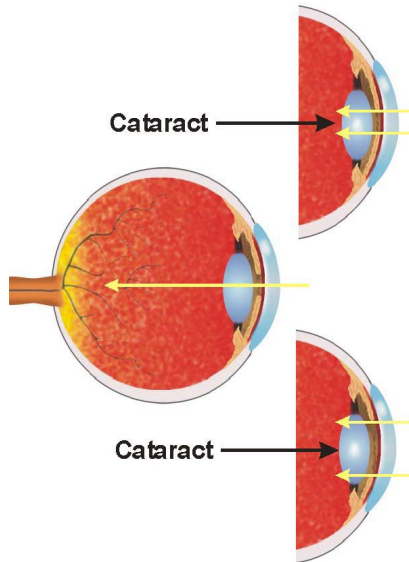


Glare from Shoreline Lighting

Shoreline illumination affects both human and aquatic life. It creates glare along the navigable channel. The bright lights prevent the eyes of boaters from adapting to the darkness. They fail to see channel markers and hazards. Without this obtrusive shoreline lighting, it is much easier to see the tree line and flotsam in the water.

Constant illumination along built-up shorelines overwhelms the cues for the changing seasons needed by aquatic wildlife. This light makes the length of the autumn night seem short and summer-like. It can also drive zooplankton to deeper waters while encouraging the growth of algae on the surface. This separation of the consumers from the food supply may stress the vitality of the ecosystem.

Our Eyes



Structure of Eye – Light Rays
with Cataracts

We use light to help us see after dark but it can have the opposite effect, especially if we are senior citizens!

After age 40, our eyes begin to deteriorate and incipient cataracts form in the centre of our lens. With glare from unshielded lights, our iris (pupil) closes down to protect the eye. Any light entering the eye must pass through the incipient cataract in the centre. Scattered light obscures the darker areas.

Without glare our iris widens and much more light passes through the clear part of our lens giving us a clearer view. So, we see better with less light!

During the day, our iris is also small but there is plenty of light from daytime scenes and our brain does a good job of correcting for our hazy vision.

Simple Solutions

As good stewards of the land and water, we must minimize our impact on the environment. The solutions to light pollution are much easier than reducing air and water pollution.

After dark, close your curtains to keep our indoor light in side. When we go to bed we should turn lights off, or at least ensure that the lights are well shielded to minimize environmental contamination. Use motion detectors instead of dusk-to-dawn fixtures. Use the lowest wattage that suits your purpose. Making light shields can be a simple activity suitable for children. Shield shoreline lights and keep them away from the water's edge, then turn them off when you go to bed. These and other examples are shown on the web at Starlight Theatre. Soon you will be able to share the night sky with your neighbours.

References:

General background information on light pollution (LP) published by the Royal Astronomical Society of Canada - www.rasc.ca/lpa/index.shtml

Essays and published articles about LP with supporting imagery and a few projects for children and adults to reduce LP. Lighting policy documents and information on Dark Sky Preserves and Urban Star Parks - www.starlight-theatre.ca/LT-POLLUTION.HTM

A large quantity of written material on LP and the reduction of glare, light trespass and sky glow. Although its main focus is astronomy, it also covers some environmental topics - www.darksky.org

Summaries and contact information on ecology of the night (scotobiology with references to researchers in the field. - www.muskokaheritage.org/ecology-night/

Compilation of research into scotobiology highlighting the environmental impact of light - Ecological Consequences of Artificial Lighting T. Longcore, C. Rich
Island Press, 2006 ISBN 1-55963-129-5