Illuminating the Effects of Light Pollution

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It is [International Dark Sky Week](http://darksky.org/dark-sky-week-2016/), an annual event when stargazers around the world raise awareness of our diminishing night sky. In many bustling cities and towns, bright lights from towering high-rise buildings, houses and street lamps obscure views of the cosmos and contribute to an environmental problem called “light pollution.”

“Light pollution is any unintended consequence of our use of artificial light at night,” said[John Barentine](http://darksky.org/about/our-staff/), an astronomer and program manager at the [International Dark-Sky Association](http://darksky.org/), the nonprofit group that helps to promote this week’s events and year-round awareness. Although measuring light pollution can be tricky, Dr. Barentine said it occurs when light is wasted either because no one is using it or because it’s superfluous.

But unlike many environmental issues, light pollution is a problem researchers say could disappear with the flick of a switch. Solutions include turning off unnecessary lights and putting shields on streetlights to direct beams downward.

Researchers want to mitigate urban illumination not just because it creates an annoyance for amateur astronomers but also because it can adversely affect wildlife and human health.

“Start thinking of a photon as a potential pollutant,” said Michael Justice, a behavioral ecologist who studies how [artificial light affects insects](https://aaas.confex.com/aaas/2016/webprogram/Paper17736.html). “Much like a chemical spill or gas leak, the photons being used to light your porch and street can unintentionally leak into surrounding areas and affect the local ecology at every level from plants to apex predators.”

[Christopher Kyba](http://userpage.fu-berlin.de/~kyba/), a physicist who studies skyglow, the hazy yellowish illumination of the night sky by artificial light, at the [German Research Center for Geosciences](http://www.gfz-potsdam.de/en/home/) in Potsdam, Germany, traced the history: For billions of years, biology evolved in a world where light and dark was controlled by the length of the day. When the sun went down, celestial sources like the moon, stars, planets and Milky Way lit the sky. Life learned to operate under their glow. Only in the last 100 years or so — with the spread of artificial light — has that cycle largely gone away.

Here are ways researchers say that light pollution influences the world around us.

**Spawning Out of Sync**

More than 130 different species of coral on the Great Barrier Reef spawn new life by moonlight. Every October or November after the full moon, the reefs spew sperm and eggs into the ocean in what looks like an underwater blizzard. When the two sex cells combine amid the flurry, fertilization begins. Bright urban lights can mask the moon’s phases, throwing the[corals’ biological clocks out of sync](http://elifesciences.org/content/4/e09991v1), according to[Oren Levy](http://www.levy-marinelab.com/), of [Bar-Ilan University](http://life-sciences.biu.ac.il/en/node/707) in Israel. This can cause the reefs to release their reproductive cells late or not at all, thwarting their chances of producing offspring.

**Beached Babies**
Baby sea turtles face a treacherous trek to the ocean after they hatch. The beach abounds with predators like gulls and crabs just waiting to pluck the newborns from the sand.

At night, beachfront lights can heighten this already herculean undertaking. Sea turtles are drawn to light, and when they emerge from their eggshells they seek out the lowest, shiniest light on the horizon, according to[Gregg Verutes](http://geointerest.frih.org/index.html), a geographer from Stanford University who has built software to help building developers understand the[effects of light pollution](http://www.sciencedirect.com/science/article/pii/S2351989414000274) and other environmental influences. For the turtles, the moon’s reflection on the ocean waves normally attracts the tiny travelers, but in some cases, bright boardwalk resorts can draw them in the wrong direction.

“Because they rely on this visual cue,” Mr. Verutes said, “when artificial light is introduced, they have difficulty moving to the ocean because that’s no longer the lowest, brightest horizon.” As a result, the hatchlings can become more vulnerable to hungry predators, dehydration and exhaustion.
 **When Birds Collide**

The allure of beams and bulbs can be a death sentence for migratory birds in cities.

“Those birds will collide with a light tower or find themselves circling in that light until they drop from exhaustion,” said [Michael Mesure](http://www.flap.org/who-we-are.php), the executive director and a co-founder of [Fatal Light Awareness Program](http://www.flap.org/), or FLAP, a nonprofit organization based in Canada that is focused on safeguarding birds. Between 100 million and 1 billion birds crash into buildings across North America every year, according to FLAP. Some of those deaths are caused by reflective windows during the day and others by bright lights at night.

Of the more than 75,000 avian dead collected by volunteers since 1993, roughly 20,000 died at night, Mr. Mesure estimated. He said that 21 of the 175 different bird varieties the organization recovered in Toronto were at-risk species.

“When dealing with a near-extinct species colliding with a lit structure,” he said, “that one bird can make or break the future of that given species of birds.”

**Not Rising to the Occasion**
Light pollution can also meddle with aquatic life in lakes. Zooplankton called Daphnia normally dwell deep below the water in the day and ascend to the surface at night to feast on algae. Darkness triggers their migration. But marine ecologists have found that[nighttime lighting can prevent](http://academics.wellesley.edu/Biology/Faculty/Mmoore/Content/Moore_2000.pdf) the zooplankton from floating up to their meals, which could lead to algae blooms that overwhelm the other life in the lake.
 **Seduced by the Glow**

We all know that insects are drawn to light quite literally like a moth to a flame. But while watching one tango with your porch light, have you ever wondered what else the creature could be doing?

“If they are hanging around the vicinity of the bulb, that takes time away from their other behaviors: feeding, finding mates, producing offspring,” said Dr. Justice, the behavioral ecologist. “It’s going to distract them from what they should be doing as moths, flies or beetles.”

He suggests swapping that porch light for a[warm colored LED](https://aaas.confex.com/aaas/2016/webprogram/Paper17736.html), which his research showed attracted fewer insects than compact fluorescent lights, halogen globes, incandescent lights and yellow “bug lights.” They also scatter less intense light into the atmosphere than blue LED lights, he said.

“When you multiply a small effect by the zillions of these light bulbs that are out there,” he said, “you can make quite a significant change in light pollution and its effects.”

**In the Human Household**Like animals, humans evolved under the reliable cycle of bright light at day and darkness at night. But today, the hallmark of the modern night is electric light, especially in our homes.

Researchers have suggested that light pollution can have adverse effects on health, saying[certain types](http://www.lightingjournal.org/xml/05839/05839.pdf) of electric lights are known to[disturb a person’s circadian rhythm](http://rstb.royalsocietypublishing.org/content/370/1667/20140120), or internal clock.

“Many people are in a circadian fog where our physiology is confused,” said[Richard Stevens](http://www.commed.uchc.edu/faculty_staff/stevens/), a cancer epidemiologist at the University of Connecticut School of Medicine. “The circadian system is not getting a clear signal of day versus night.”

The electric lights, he said, may influence the body’s production of melatonin, a hormone that helps regulate the internal clock.