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# A Silent Cry for Dark Skies

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Many of us live in a world of urban constellations, unable to see the stellar constellations a moderately dark sky would provide. We should ask ourselves whether this is the legacy we wish to leave our children. The dark sky is a natural resource that should be protected. The ongoing loss of a dark night sky for much of the world's population is a growing, serious issue that impacts not only astronomical research, but also human health, ecology and ecosystems, safety and security, and energy conservation. Up to $10 billion dollars is wasted each year in the United States by lighting up the underbellies of birds and clouds.[1,2] According to the United Nations, 2008 will be the first year in which 3.3 billion people, over half of the world's population, will live in cities.[3] With the growth of large cities in Africa and Asia, the number of people living in cities could climb to 5 billion by 2030. As cities grow, so does their impact on the global environment.

In particular, light pollution has a negative influence on a variety of animals and plants in a variety of ways. It has been shown to disorient animals. Light pollution affects mating, alters predator-prey behavior, confuses migration, and influences animal physiology. Effects have been observed over a full range of taxonomic groups, including birds, reptiles, mammals, amphibians, fishes, invertebrates, and plants. Here in particular we will discuss the effects of nighttime artificial lighting on sea turtles, birds, frogs, salamanders, insects, plants and fish.

## Sea Turtles

Constant artificial night lighting may disorient animals accustomed to navigating in the dark. The most well-known example of this is the disorientation of sea turtles hatching from nests on coastal beaches. Under normal circumstances, hatchlings move away from low, dark silhouettes (e.g., of dune vegetation), allowing them to quickly locate and crawl into the ocean. With beachfront lighting, the silhouettes that would have cued movement are no longer visible, resulting in disorientation.[4] Lighting also affects the egg-laying behavior of female sea turtles.[5,6]

Hawaiian Green Sea Turtle

## Birds

Birds can be disoriented by artificial lights at night.[7] A prime example is juvenile seabirds as they leave their nests and fly out to sea. Lighted towers and tall buildings can confuse migrating and local birds, leading to collisions with other birds, structures or windows, or circling the lights until they die of exhaustion. Artificial lighting has attracted birds to smokestacks, broadcast towers,[7] lighthouses,[8] boats,[9] greenhouses, oil platforms,[10] and other structures at night. Estimates by the U.S. Fish and Wildlife Service of the number of birds killed after being attracted to tall towers range from 4-5 million per year to an order of magnitude

higher.[11] The Fatal Light Awareness Program (FLAP)[12] works with building owners in Toronto, Canada and other cities to reduce mortality of birds by turning out lights during migration periods.

Blacktailed Goodwits

Some evidence suggests that artificial lighting at night affects the choice of nesting sites for birds. One example is black-tailed godwits in wet grassland habitats.[13] Over 2 years, breeding densities of godwits were recorded. Lighted and unlighted conditions near a roadway and near light poles were compared. When all other habitat factors were taken into account, the density of nests was statistically lower up to 300 meters away from the lighting at roadway and control sites. Researchers also noted that birds nesting earlier in the year chose sites farther away from the lights, while those nesting later filled in sites closer.

## Frogs and Salamanders

Changes in light level may also disrupt orientation in nocturnal animals. Rapid increases in light can blind animals, like frogs. The recovery time for frogs may be minutes to hours.[14] After getting used to a light, frogs may be attracted to it as well.[15] Artificial night lighting may also affect reproductive behaviors. For example, female physalaemus pustulosus frogs, are less selective about choosing a mate choice when light levels are increased, presumably preferring to mate quickly and avoid an increased chance of predators.[16] Sky glow around sports stadiums caused by artificial light at night can halt the mating activity of nearby frogs. Like nocturnal frogs, salamanders are also affected by light pollution. As nocturnal animals, they wake up when there is no light. Light pollution may cause salamanders to come out from undercover later, giving them less time to mate.


Elertherodactlus guttilatus

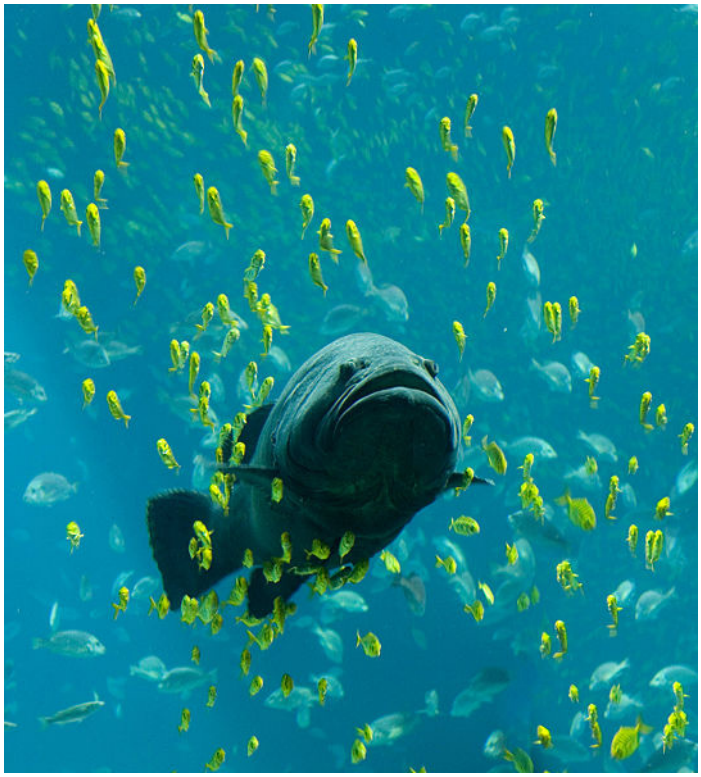
## Insects, Plants and Fish

Moths, like many groups of insects, are attracted to lights.[17] Entomologists have documented that artificial light at night may interfere with the ability of moths and other nocturnal insects to navigate.[18] As a result, night blooming flowers that depend on moths for pollination may be affected. This can lead to the decline of a plant species because they are unable to reproduce and would change an area's long-term ecology. Other insects attracted to lights include beetles, bugs, bush crickets, caddisflies, crane flies, hoverflies, lacewings, midges, and wasps.[19,20] Glowworms and fireflies are among species that communicate through light (bioluminescent flashes). Artificial lighting can greatly reduce their visibility.

Moth

Studies suggest that light pollution around lakes prevents zooplankton, such as Daphnia, from eating surface algae, helping cause algal blooms that can kill off the lakes' plants and lower water quality.[21]

The use of intense lights for fishing at night attracts large numbers of fish. This method leads to over-fishing and contributes to the decline of fish worldwide. Artificial lights at night have caused behavioral and physiological changes in salamanders as well.



Giant Grouper

In summary, whether outdoor light is directly next to a species habitat or located at some distance, as through sky glow, the combined effects of artificial lighting on vast numbers of nocturnal species have the potential to disrupt the functioning of entire ecosystems by disrupting balances in competition and the predator-prey relation, among others.

## A Global Problem with a Local Solution: The GLOBE at Night Program

The dark-skies education efforts described below aim to heighten awareness of light pollution as a global problem with a local solution. Education efforts have proven to be most effective when people get physically involved. For example, "star hunts" or "star counts" provide people with a fun, fast and no-frills way to acquire heightened awareness about light pollution through firsthand observations of the night sky. Over the past two years the GLOBE at Night program (led by National Optical Astronomy Observatory (NOAO) and the GLOBE Program educational outreach staff) has enabled thousands of citizen-scientists around the world to contribute measurements of their local sky brightness to a growing global database in two ways: simple unaided-eye observations that anyone can do and quantitative digital measurements through a handheld, well-calibrated sky-brightness meter. Indeed, GLOBE at Night represents a landmark in the emerging informal science education thrust of citizen-science projects. See http://www.globe.gov/globeatnight/ on how you can participate.