

# Astronomy and the Environment: Preserving the Night Sky for Everyone



An informational resource provided by  
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[www.cosmicconversations.org](http://www.cosmicconversations.org)

# Light Pollution over time



Los Angeles 1908



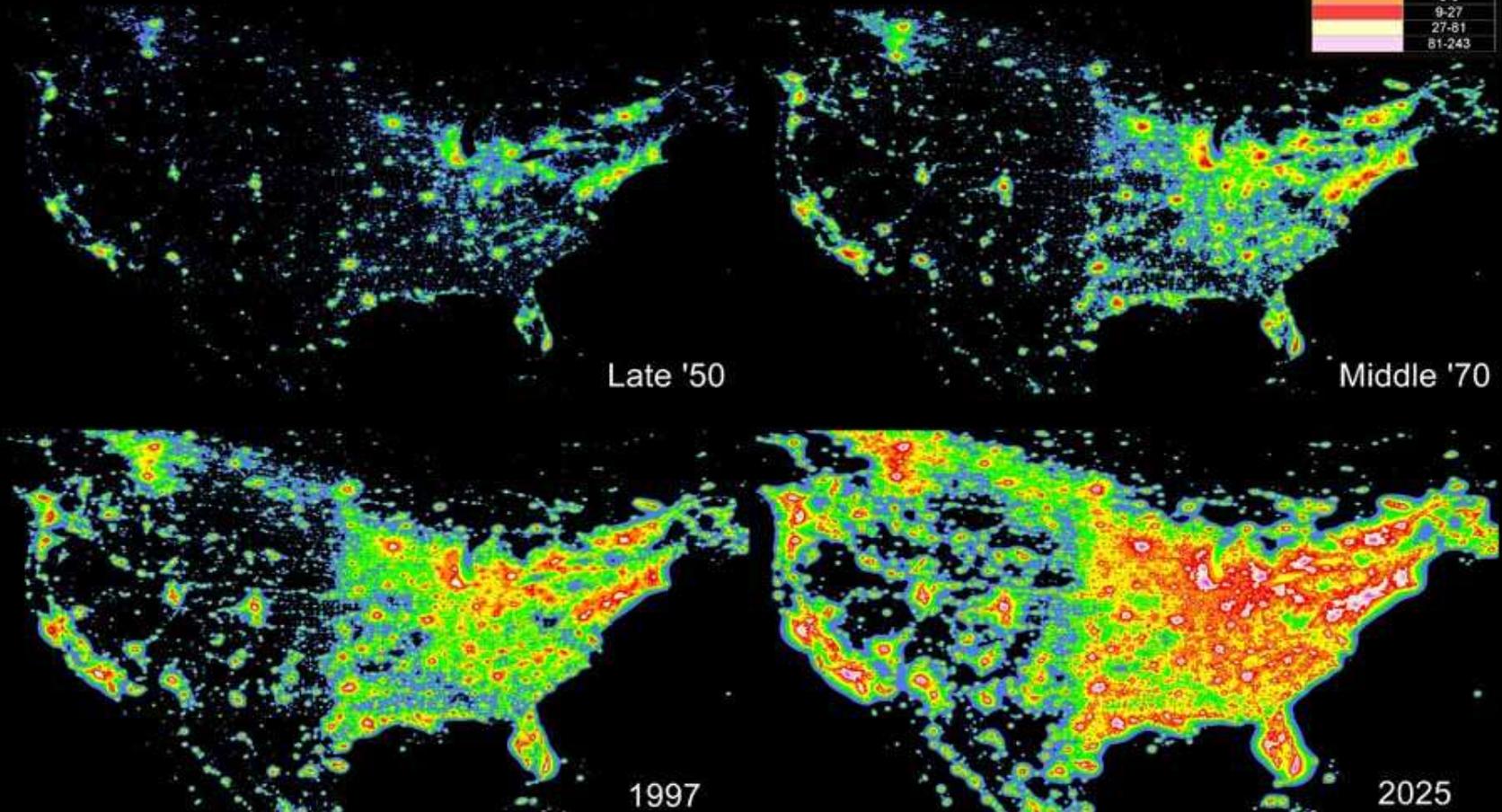
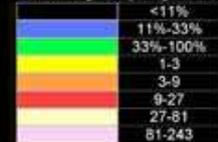
Los Angeles 1988

# Progression of Unmitigated Light Pollution

Average yearly growth rates of light pollution is as large as 5%-10% measured both in US and Europe

Artificial Night Sky Brightness due to Light Pollution in North America  
A preliminary picture of the growth from 1950 to 2025

Artificial night sky brightness at zenith, at sea level, for standard clean atmosphere as fraction of the average natural night sky brightness



# Light Pollution

**Definition:** Light pollution is excess or obtrusive light created by humans.

Effects:

- obscures stars and interferes with astronomical observatories (astronomical light pollution)
- disrupts ecosystems (ecological light pollution)
- wastes energy
- can cause adverse health effects
- Is a form of pollution as serious as air, water and land pollution

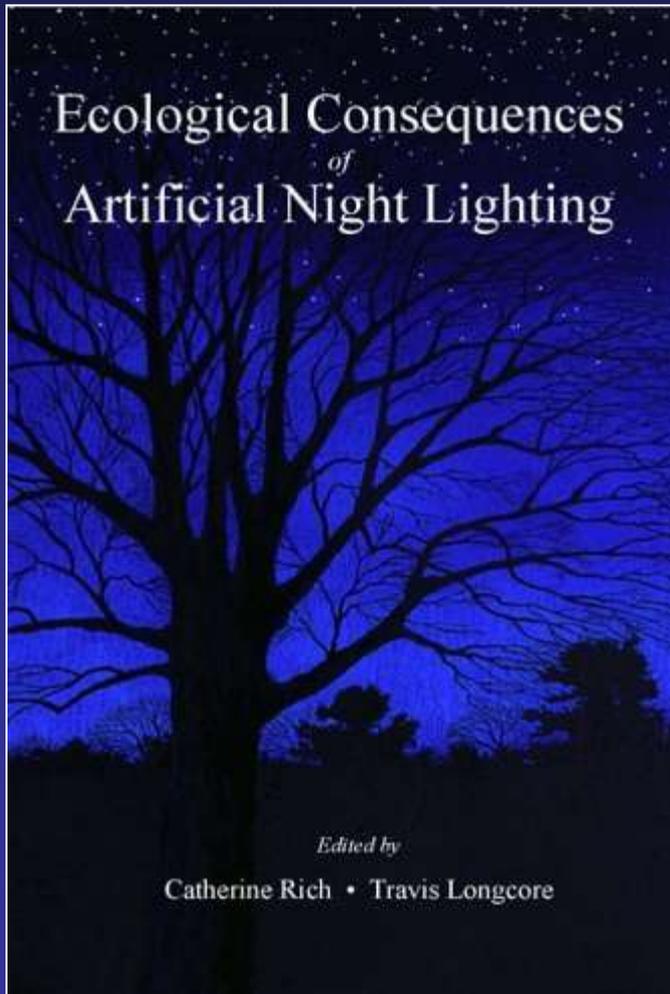
Flora and fauna have evolved over hundreds of millions of years in a bright day - dark night cycle, with moon phase stimulated behaviors.

Light Pollution dramatically disrupts habitats and behaviors of:

- Birds (hundreds of millions of birds die every year due to upwardly directed night lighting)
- Amphibians
- Fish
- Insects
- Mammals (including humans)

Night lighting results in ecological disturbances and mortality of individuals and entire species in ways that are still being discovered in every study conducted.

# Reaction of Plants and Animals to Light Pollution



- LP may interfere with mating activity among nocturnal species and discourage zooplankton from feeding on algae.
- LP can delay nightly feeding excursions of nocturnal animals resulting in food intake limitations, stunted growth and depressed reproduction and survival.
- Strong lights attract certain insects away from darker areas hunted by nocturnal insectivores.
- Migrating birds navigating by starlight can be lead astray by lights, crashing into lit towers/buildings or circling until they become exhausted and fall to the ground.

# Birds

## Bird Migrations

An estimated 550 million migrating birds die every year when they are thrown off course by bright, upwardly directed night lighting, and when they die in collisions with lit structures or from exhaustion when circling them.

Predator-Prey relationships are altered: Crow and pigeons have been found to be greater in number in all-night lighted areas because owls and predators will not thrive there.

Circadian Rhythms: Disruptions in day-night cycle can affect song times for songbirds, affecting mating cycles

# Light Pollution—Plants affected

Plants have up to nine different photoreceptors – very sensitive to light

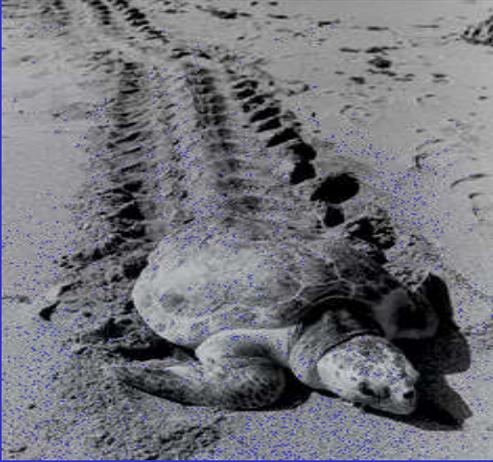
Alteration of growth patterns, flowering, dormancy and pollination

Trees are stressed and die prematurely when dormancy delayed and growth altered. (Purdue University)

Soybean plants as far as 100 ft from prison security lighting are prevented from developing normally.

Deciduous plants (shed leaves as days grow short in the fall) are thought to be most susceptible to artificial light.

# What's being done to help the environment?



- **SEA TURTLES** - first identified light pollution indicator organism. Led to nation's first public outdoor lighting ordinance in Florida for wildlife conservation purposes.



- **SW USA ENDANGERED CAT SPECIES** - US Border Patrol proposes putting up bright lights along US-Mexico border inhabited by endangered cats. USFWS presses for Environmental Impact Statement (EIS).

■ **BIRDS – FLAP** (Fatal Light Awareness Program) Highly successful Canadian public program aimed at reducing birds kills from collisions with lighted city buildings. Program identifies numerous bird species at risk from light pollution.

Visit [www.flap.org](http://www.flap.org)



**Lights Kill Birds.**

Lured by lights at night, migrating birds crash into buildings.

We can all help save birds' lives and save electricity and money too.

Be part of **Lights Out Toronto.**

**Turn out lights**, at work and at home.

For more information and ways to help, visit [www.toronto.ca/lightsout](http://www.toronto.ca/lightsout) or call 416-366-FLAP (3527).



**TORONTO**

**FLAP**

Toronto Hydro Corporation

Environment Canada  
Canadian Wildlife Service

Environment Ontario  
Service à l'écologie  
de la ville

**BOMA**

Toronto Wildlife Centre

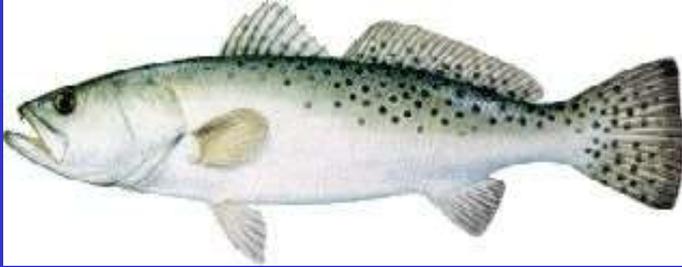
Conservation  
for The Living City

**toronto ZOO**

5 **years to**  
**recharge**

**HUMANE SOCIETY**  
**INTERNATIONAL**

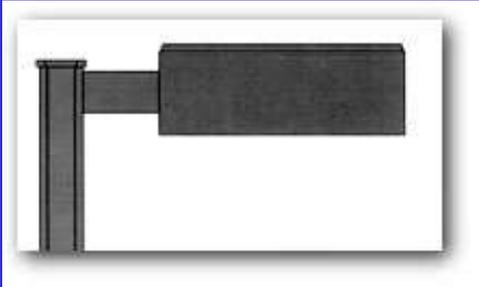
**Lights Out** - Many US cities are sponsoring highly successful “Lights Out” programs to ask building owners to dim or turn off building lights at night.



■ **SPORT FISHES** - Scottish fisherman won a civil court case involving seatrout populations being affected by local light pollution



■ In State of Washington, light trespassing into fish habitat from unshielded lights on Cedar River interfered with sockeye salmon fry migration. Successfully resolved with proper light shielding.



■ **US NATIONAL PARK SERVICE** is responding to public concerns about light pollution by retrofitting existing lights with full cut off optics (FCO).



■ **MIGRATORY BIRDS** - mortalities from collisions with lighted buildings and towers has led to USFWS guidance on lighted towers.

# Light Pollution affects Human Health

- Interferes with circadian rhythms
- Melatonin suppression
- Sleep disturbances
- Suspected in rise in childhood leukemia

\* Researchers: Blask, Pauley, Brainard, Rea, Schernhammer, Crain

# Circadian Rhythm Disruption

- Our bodies need daily exposure to total darkness – basis of circadian rhythms (internal clock)
- Very important for hormonal and metabolic systems of the body

Disruption of circadian rhythm has been linked to:

Obesity and diabetes      bipolar and sleep disorders

Depression      sleep disorders

Several types of cancer, esp breast cancer

(International Agency for Research on Cancer (IARC) recently declared circadian-rhythm disruption as a class 2A carcinogen — placing it on the same level of severity as the effects of tobacco smoke or lung cancer.)

# Other effects

- Increased psychological stress of exposure to too much light
- Children who sleep with light on are more likely to be short-sighted and need glasses
- Lack of sleep from excess light can suppress the immune system and lead to further disorders

# Costs of Light Pollution

Half of the light used for lighting in the US is wasted, shining upwards into space and causing light pollution!

Annual cost of direct up light from streetlights:

Over \$2 Billion Dollars;  
Maybe as high as \$5 billion

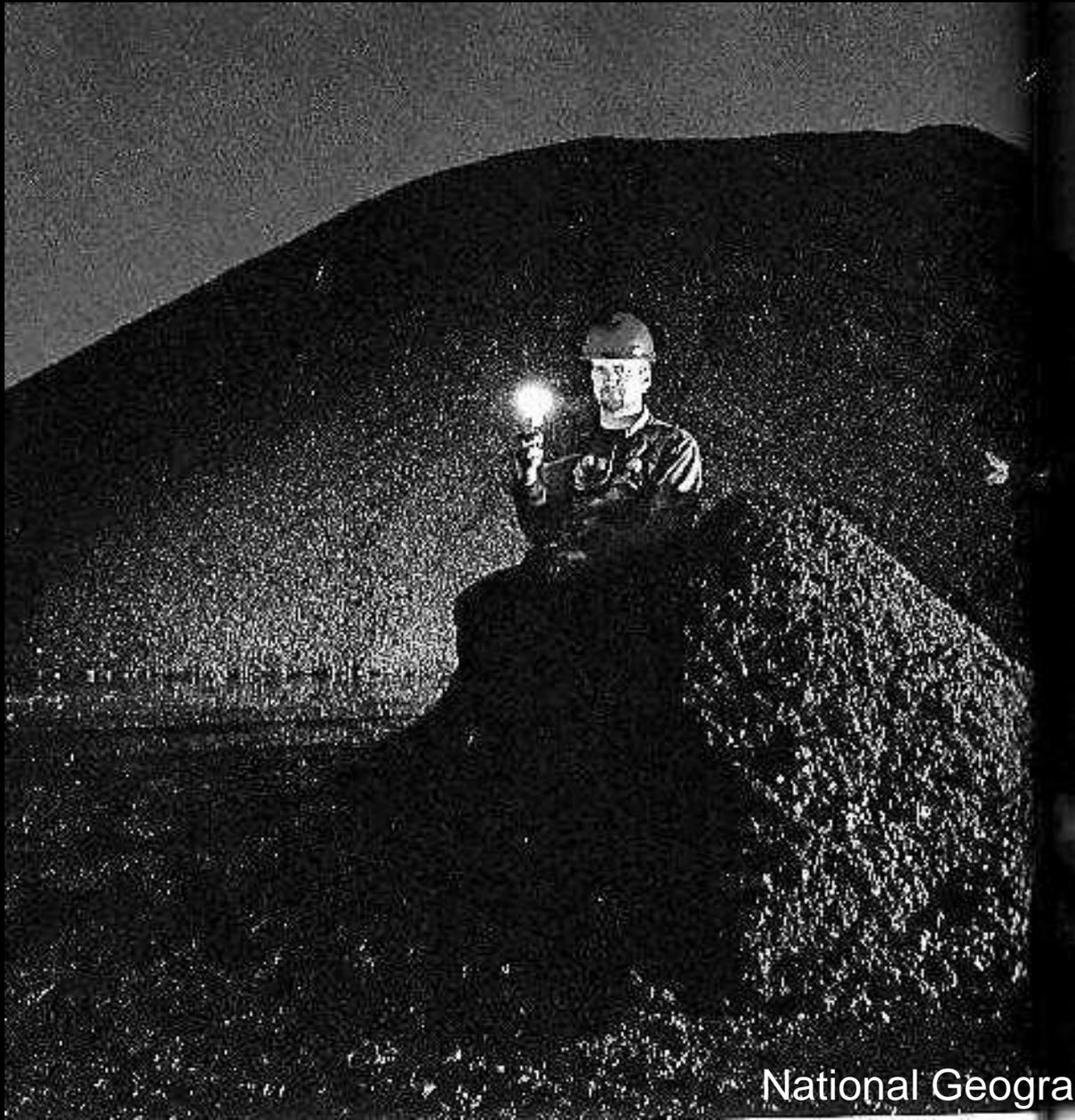


Lighting is responsible for one-fourth of all electricity consumption worldwide

- 30% of night lighting estimated to be expended upward by unshielded or excessive lighting.
- ESTIMATE:= \$4,500,000,000+ per year in the U.S. wasted
- Consuming: 6 million tons of coal  
23 million barrels of oil per year

Public lighting is one of the largest sources of  
Greenhouse Gas Emissions

One half ton of coal is burned to produce 100 watts of incandescent dusk-to-dawn lighting



National Geographic Magazine

# Light Pollution = Air Pollution

- Every kilowatt causes release of:
  - 1.3 pounds carbon dioxide
  - 2 grams sulfur dioxide
  - 1.6 grams nitric oxide

Yearly:

- 62 billion kWh = 40 million tons of CO<sub>2</sub>  
= 1.4 million tons SO<sub>2</sub>  
= 1.1 million tons NO

# What can you do?

- Properly shield light fixtures
- Use lower wattage bulbs, CFLs, or LEDs
- Use directed lighting, and sensor-based lights
- Petition local and state governments to revamp old lighting codes and install “dark-sky” friendly fixtures
- Spread the word to neighbors and friends

**\*All of these save energy and money and\*  
protect the environment! No downside!**



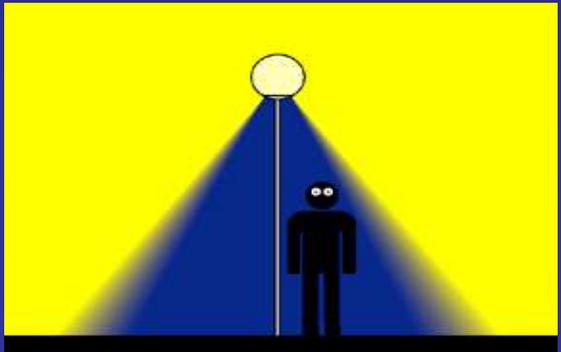
### Good lighting (note: fully shielded)

- \* Directs light down (No light above horizontal)
- \* Does not produce glare.
- \* Reduces light trespass.
- \* Provides even illumination allows us to see the objects being lit and not the light source.



### Poor Lighting

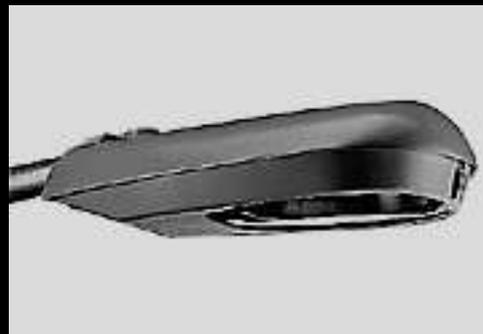
- \* Up Light wastes energy.
- \* Causes Glare, Light Trespass and harsh illumination.
- \* Glare reduces our eyes' ability to see properly in the dark. Results in eye strain/fatigue.



### Extremely Poor Lighting

- \* Lights everything but what we want!
- \* Produces extreme Up Light, Glare, and Light Trespass!

# # 1 Most effective Solution for Light Pollution: use shielded fixtures



**Fully Shielded Flood Lights Prevent Light Trespass**  
**If for security, then use a motion sensor.**  
**If for ornamental, then use a timer.**

## **POOR FLOOD**



## **GOOD FLOOD**



**Anyone want this house as a neighbor?**

**Good news – unlike other types of pollution, light pollution is comparatively easy to fix and shows immediate results**

	<u>Chemical</u>	<u>Light</u>	<u>Examples</u>
▪ Habitat Modification	yes	yes	coastal ecosystems
▪ Population Effects	yes	yes	sea turtles, birds
▪ Pollutant Environmental Fate	persistent or short-lived	persistent	ubiquitous in urban/ industrial environments
▪ Ecological Imbalance	yes	yes	coastal ecosystems
▪ Environmental Restoration	expensive \$\$\$	cheap \$	Florida coasts Cedar River, WA
▪ Restoration benefits	long term	immediate	Florida coasts Cedar River, WA

**But its severe effects need to be recognized and regulated like other environmental pollutants!**

The night skies belong to all of us and are here for everyone – its an area where each one of us can make a contribution that will have lasting effects, not only for ourselves, but for our communities and the natural world around us for generations to come.

**What a difference a little light makes – the choice is our**

