

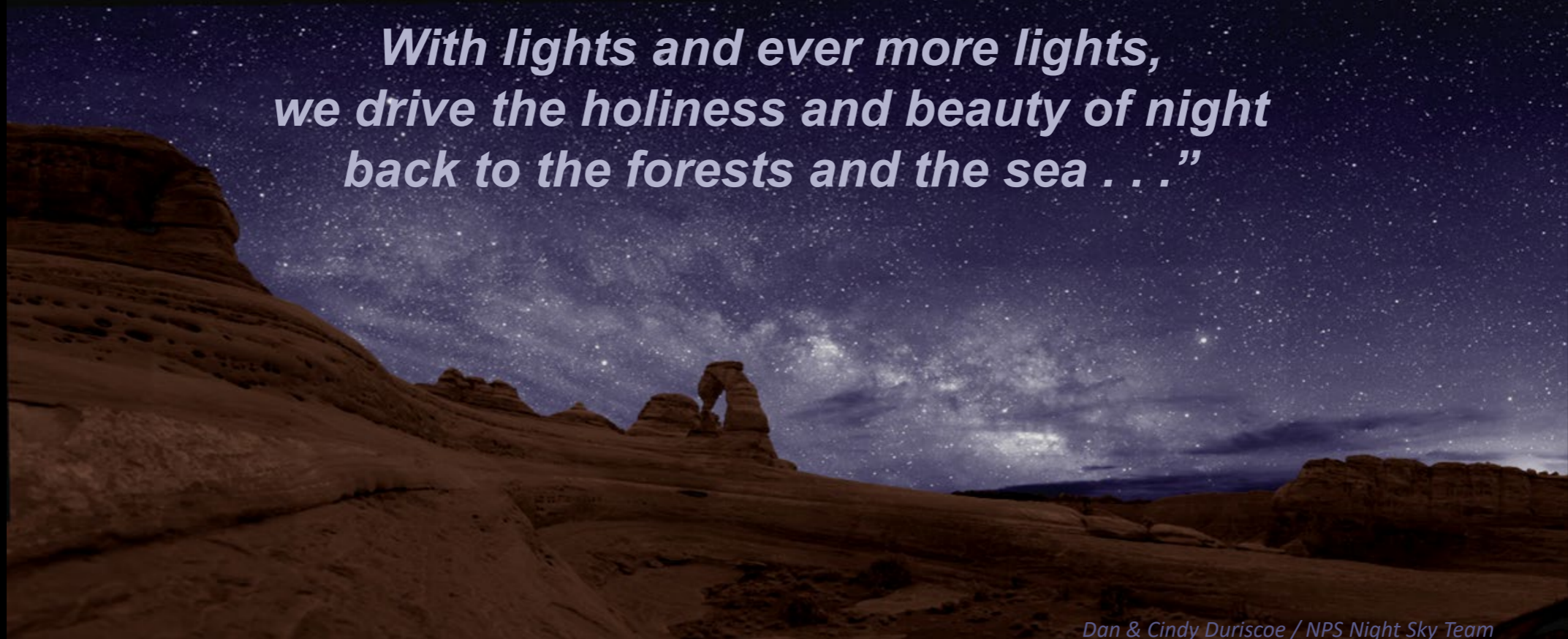
Darkness in Distress: Halting the Rise of Light Pollution



Dan & Cindy Duriscoe / NPS Night Sky Team

***“Our fantastic civilization has fallen out of touch
with many aspects of nature,
and with none more completely than with night . . .***

***With lights and ever more lights,
we drive the holiness and beauty of night
back to the forests and the sea . . .”***



Dan & Cindy Duriscoe / NPS Night Sky Team

**Henry Beston, “Night on the Great Beach”
from *The Outermost House* (1928)**

Light Pollution

Illumination of the night sky by artificial light sources.

Includes glare, trespass, and disturbance of the natural nighttime landscape.

Much of this light never touches the ground.

Instead, it shines straight up into the sky.





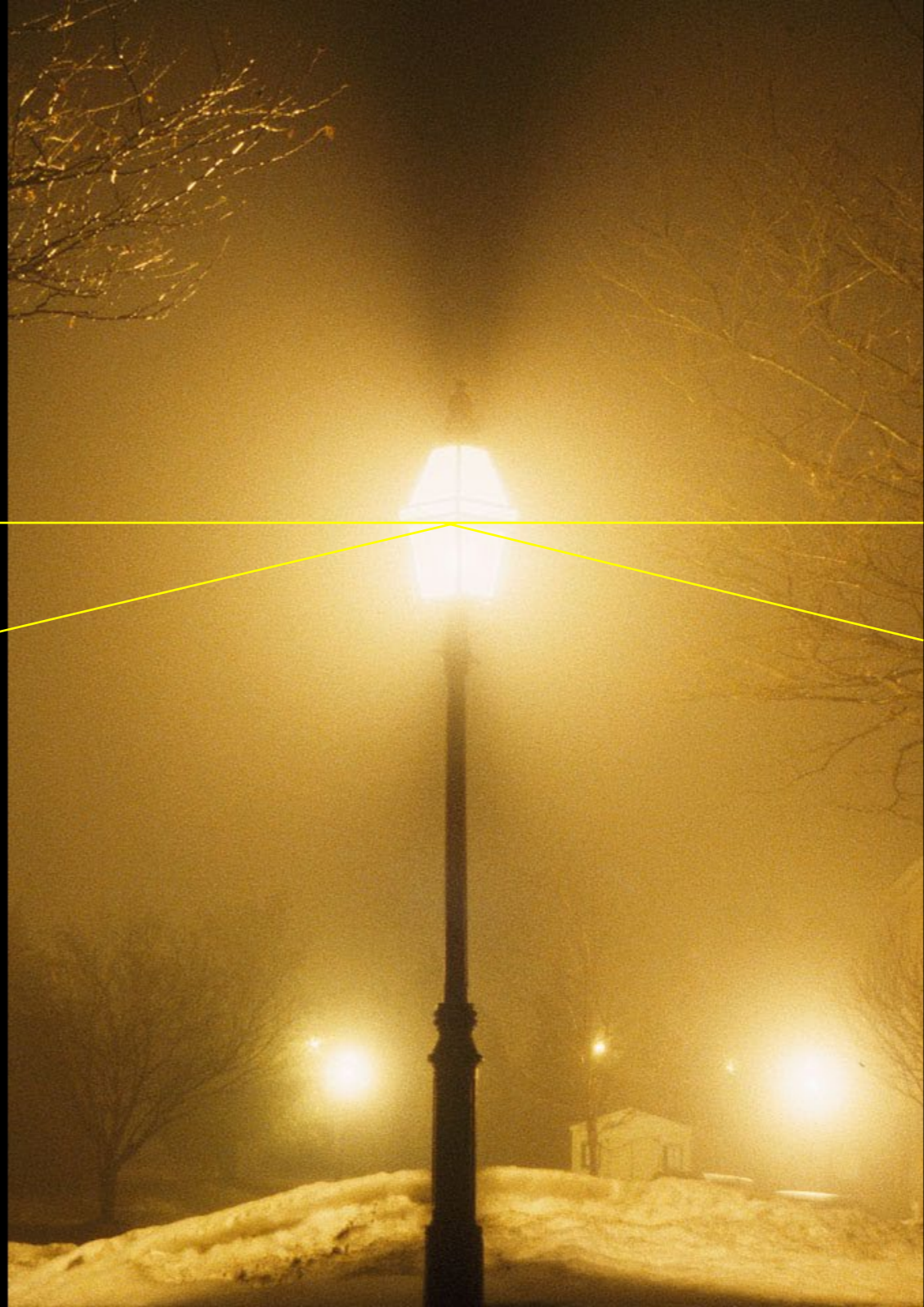
Uplight



Glare



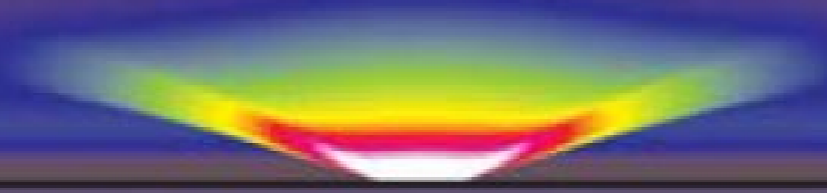
Useful



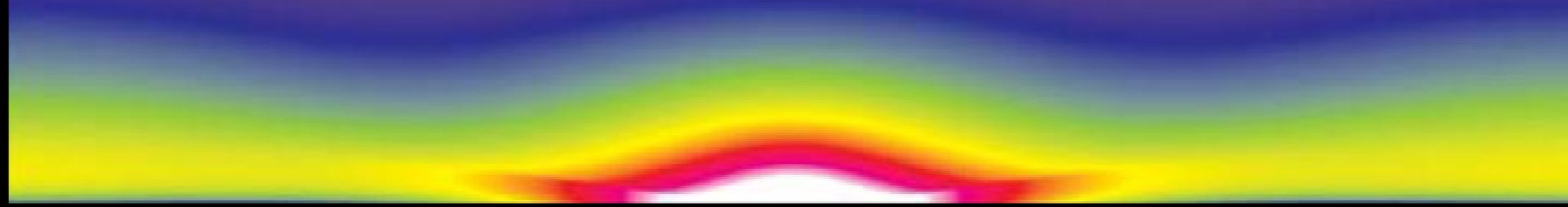
20°–30°



60°–70°



80°–90°



Streetlights



Security Lights



Snap-on



Floodlights



Floodlights



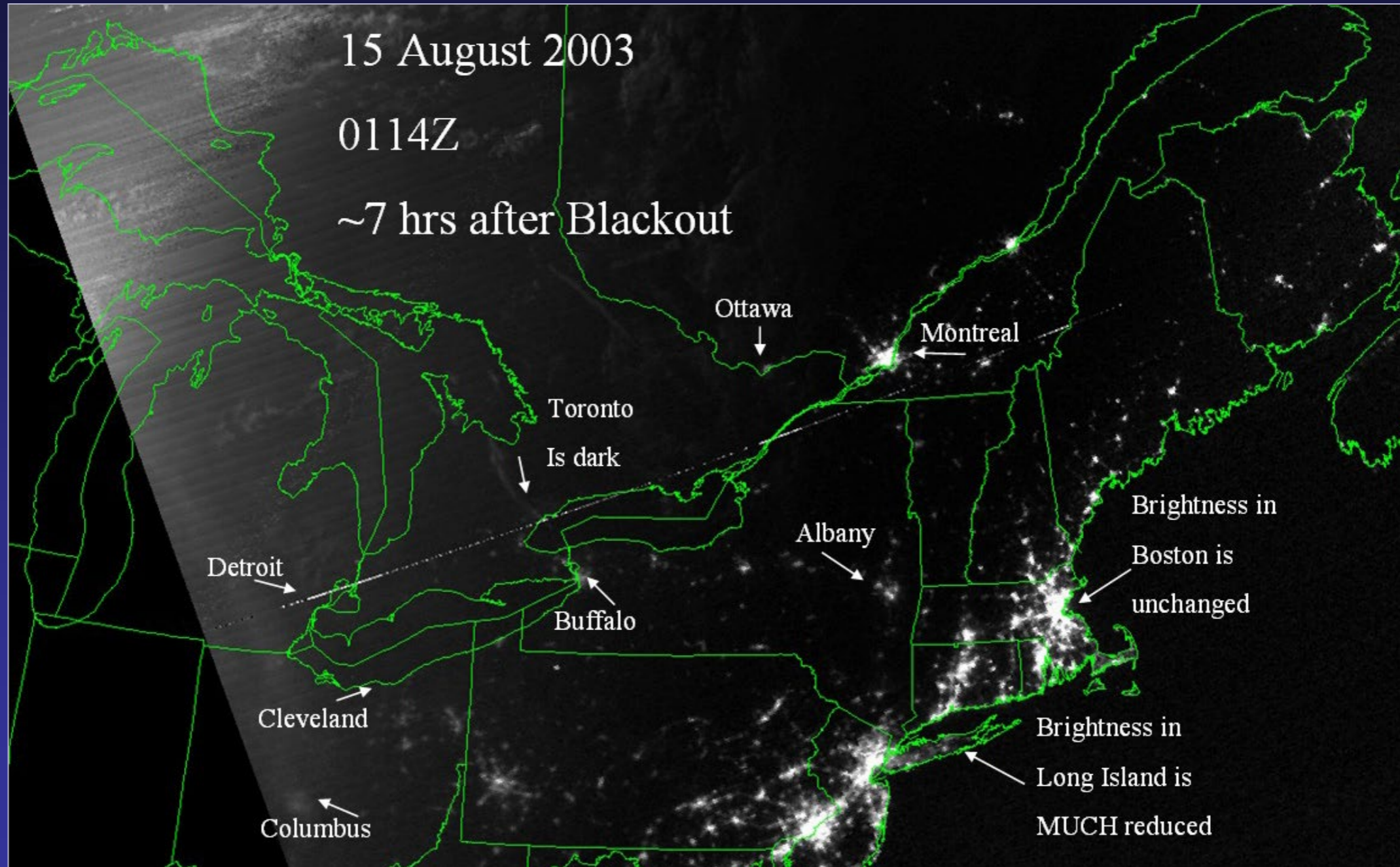
Sports Lighting



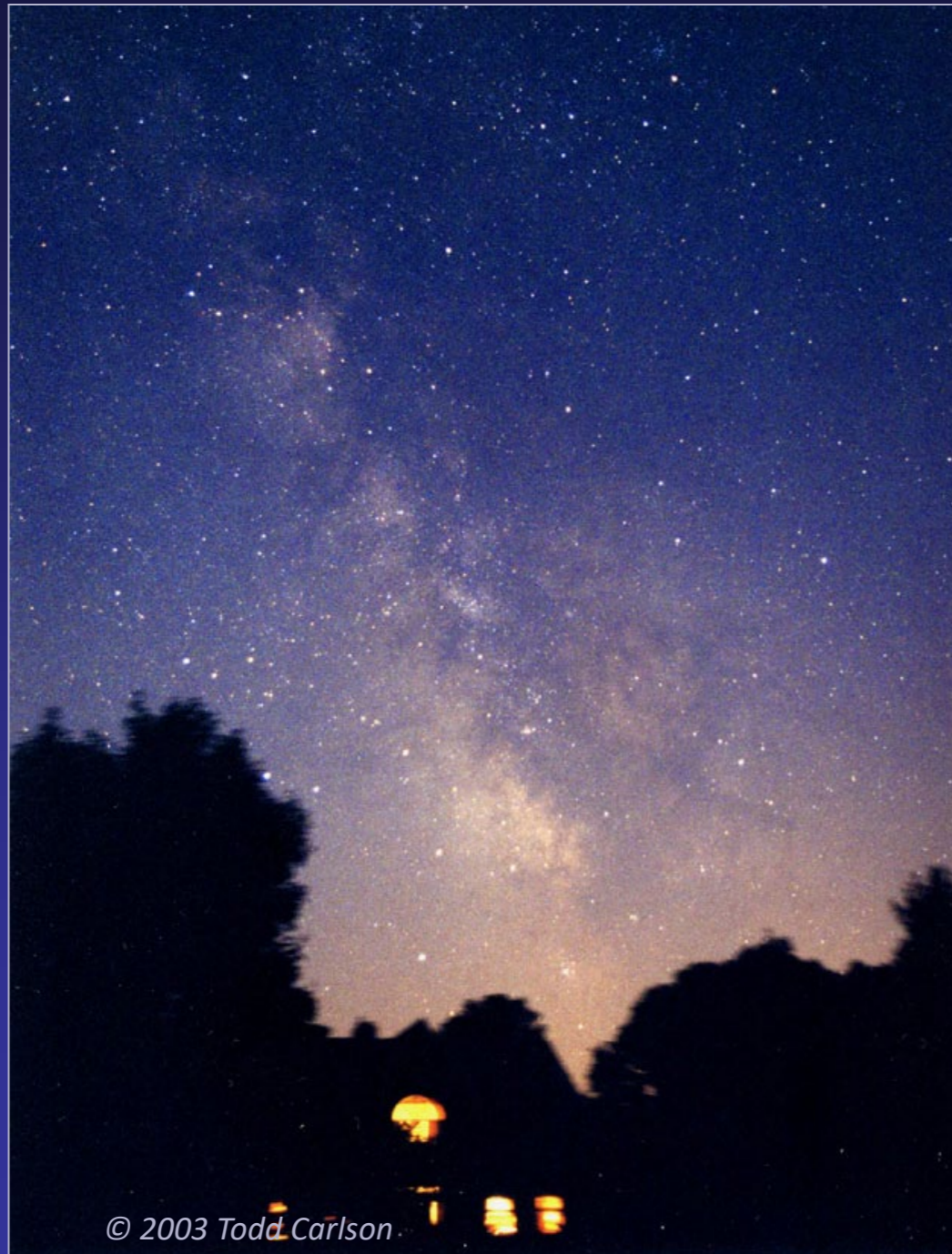
Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**

The Great Northeast Blackout



The Great Northeast Blackout



© 2003 Todd Carlson



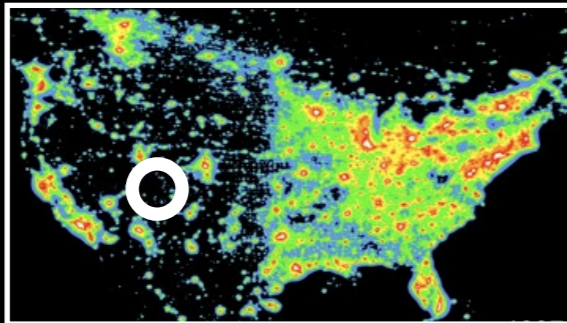
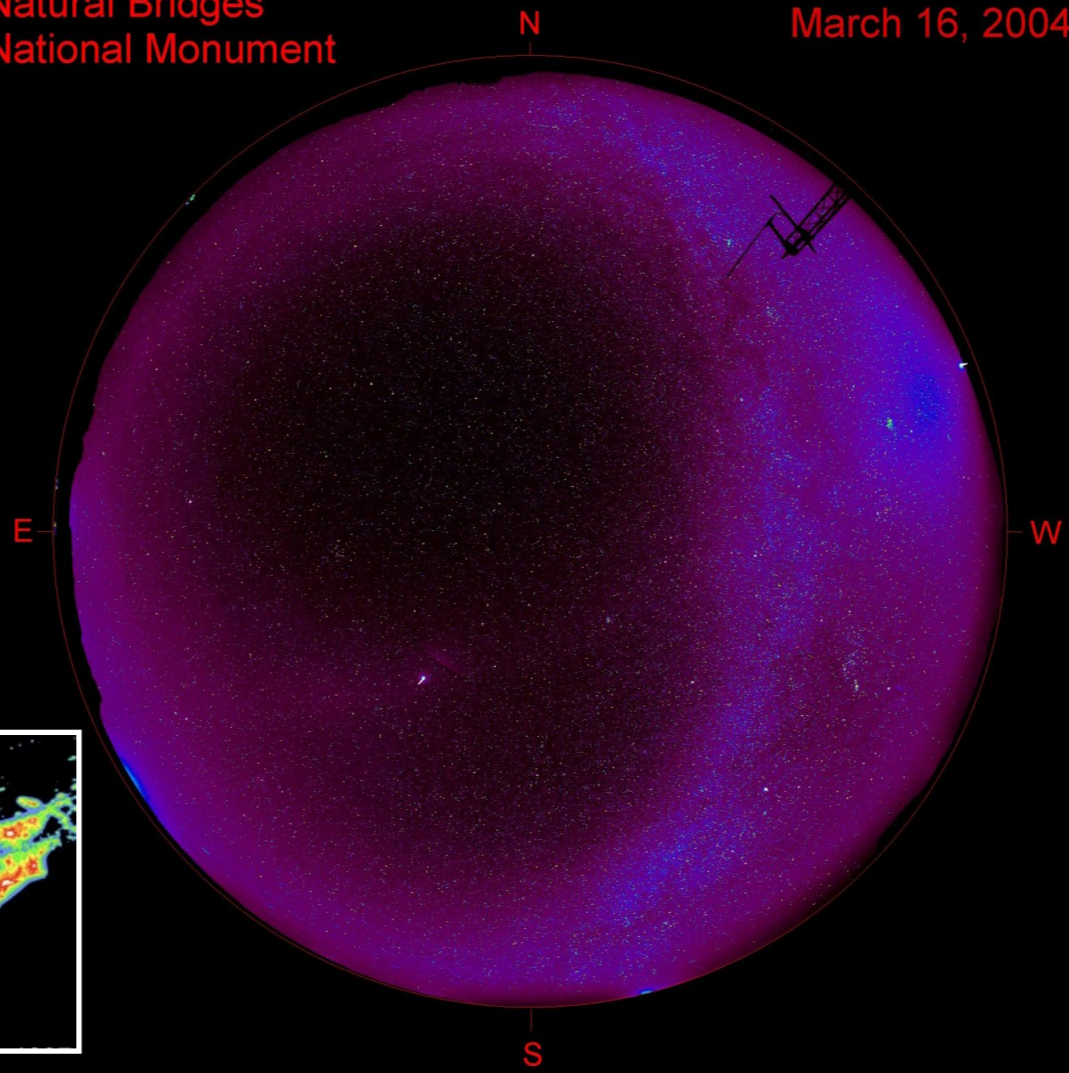


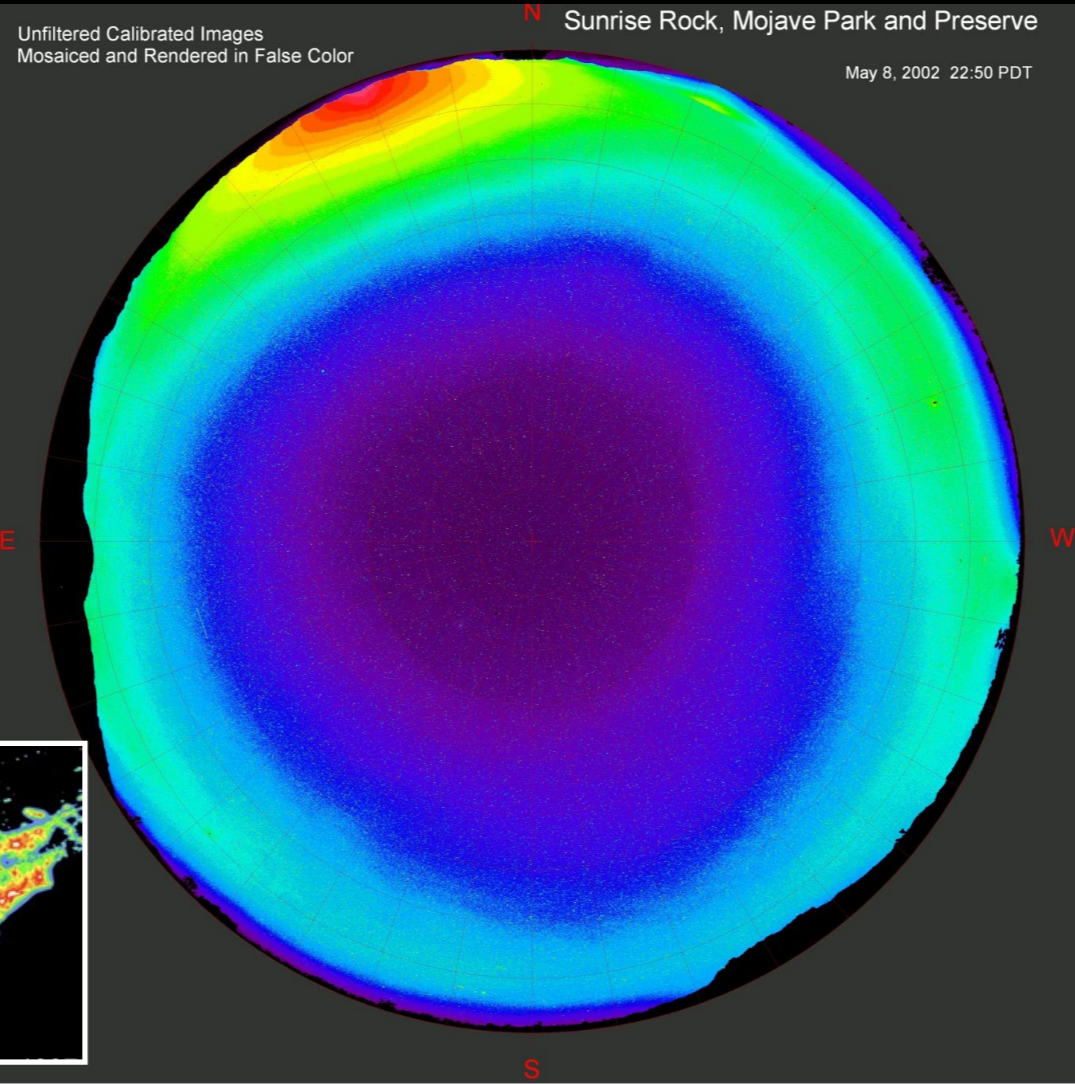
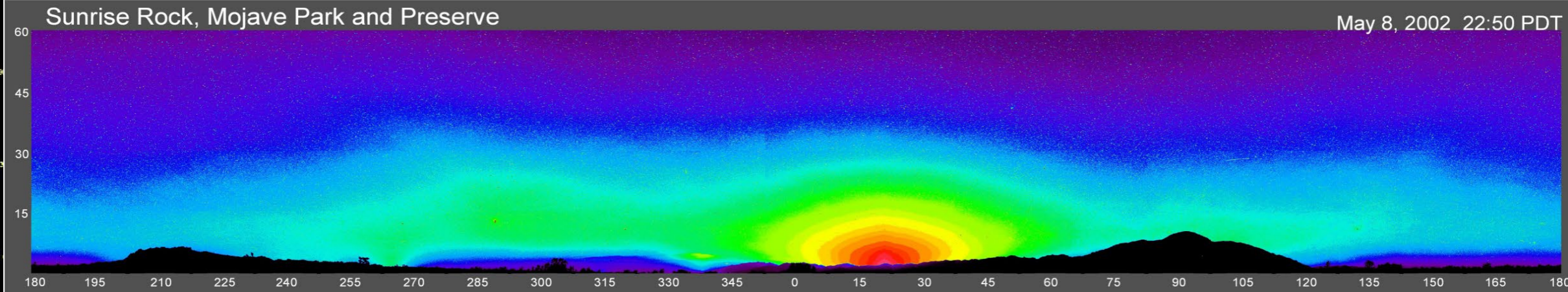
Natural Bridges
National Monument

March 16, 2004

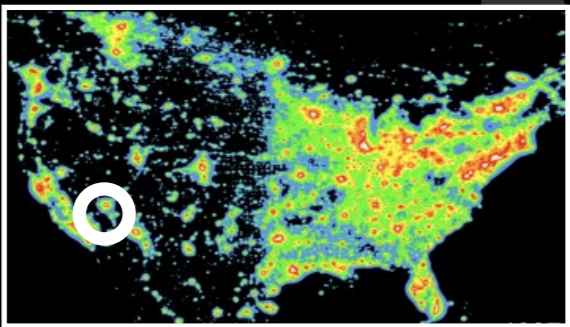
Natural Bridges Nat'l Monument in Utah

(IDA Dark Sky Park)

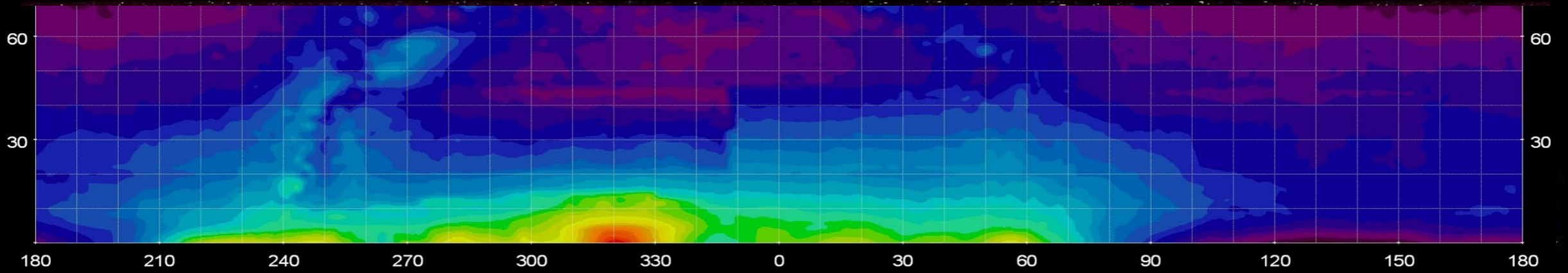




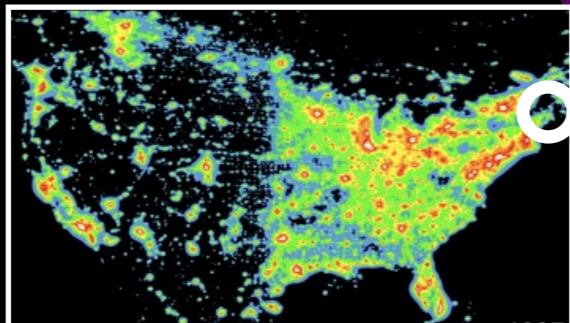
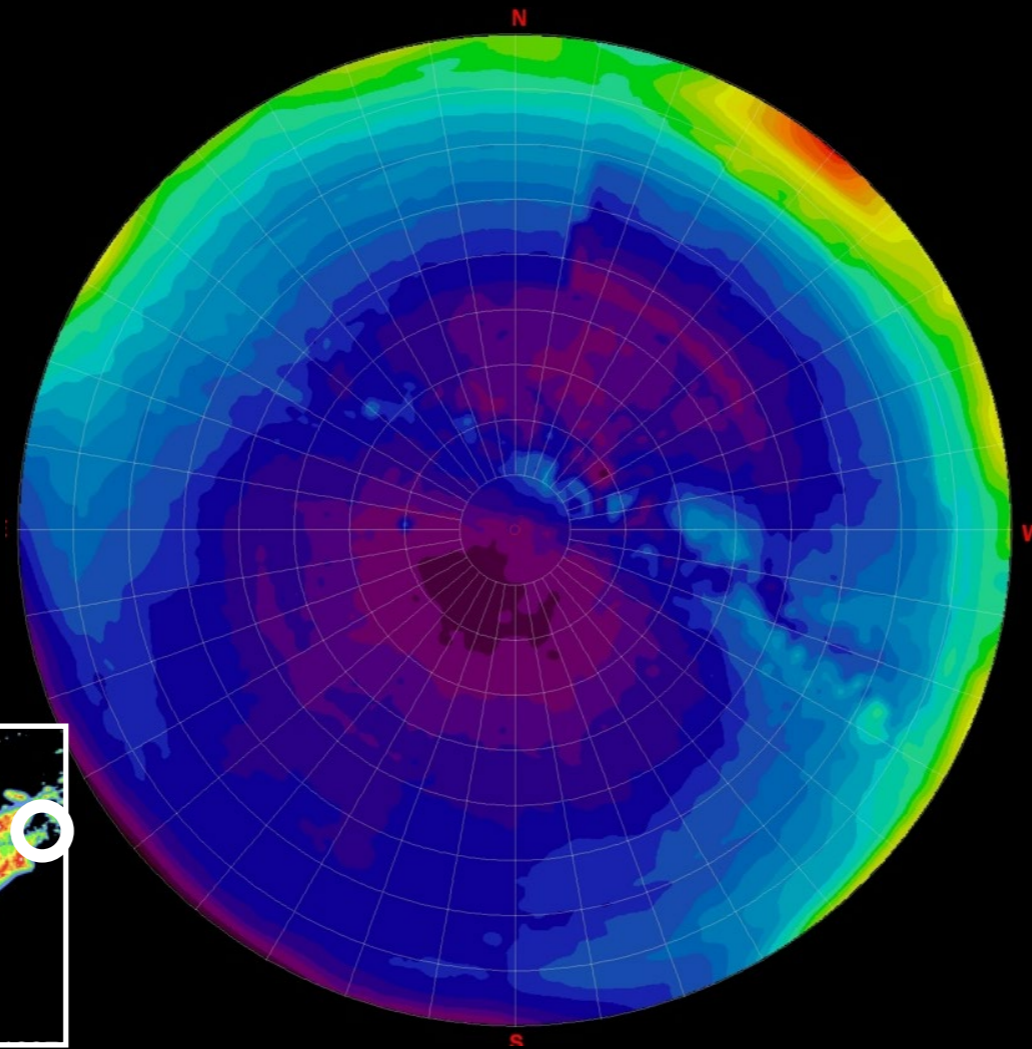
**Mojave National
Preserve, CA**
(Las Vegas, NV)







Acadia National Park
(Bar Harbor, ME)

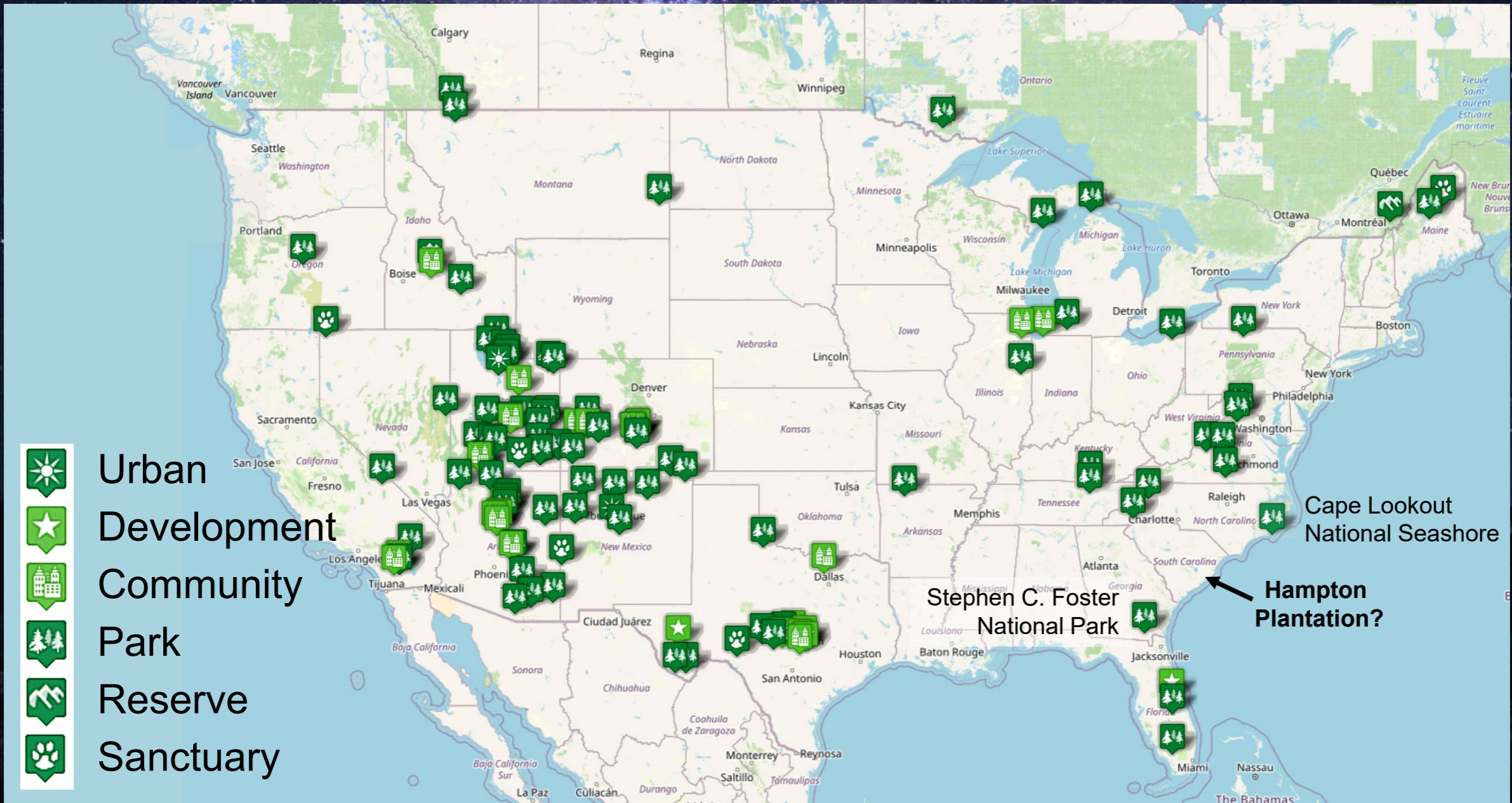


Yosemite National Park



Erich Herrmann

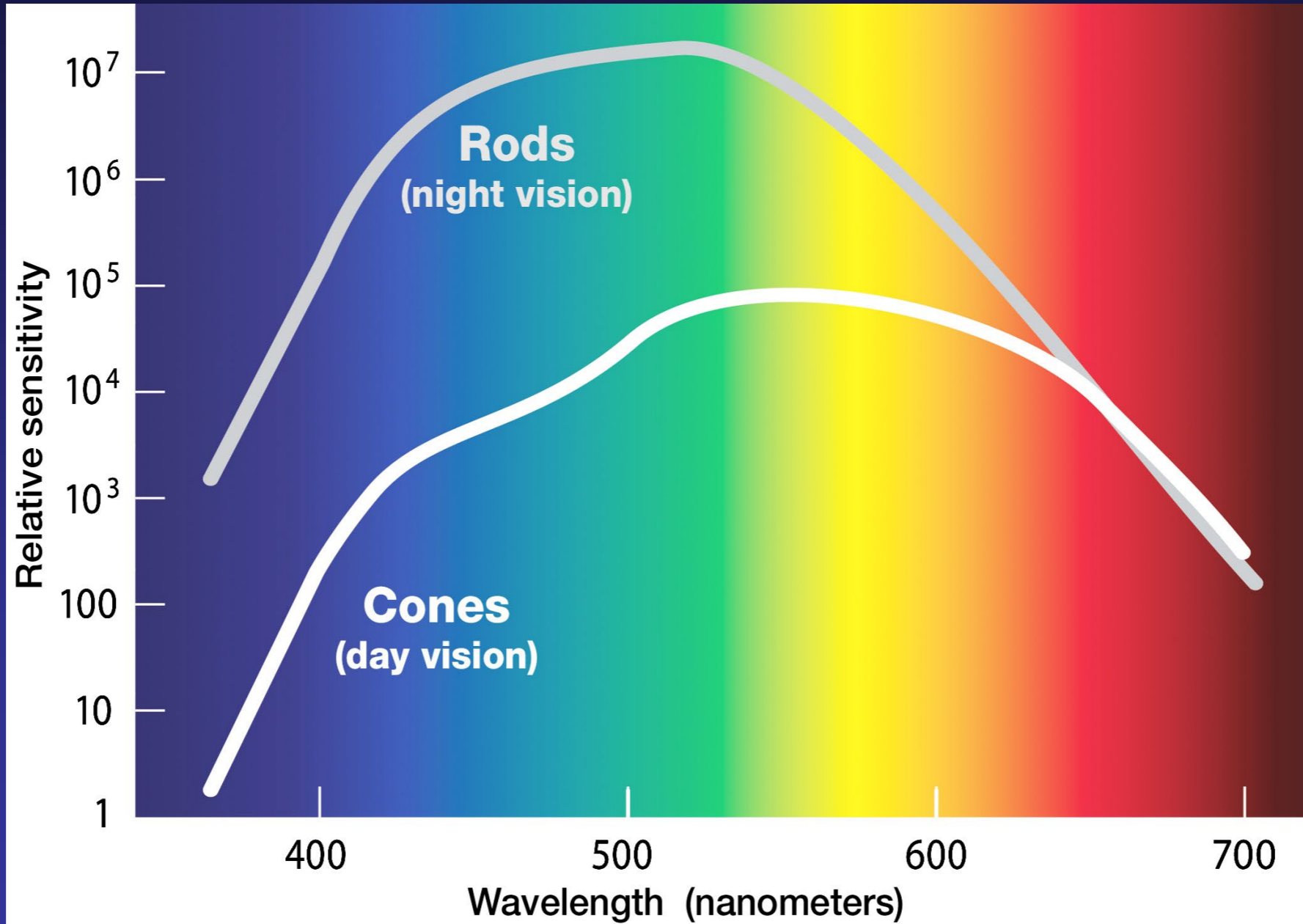
IDA Dark-Sky Places



Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**

Your Eyes and Light







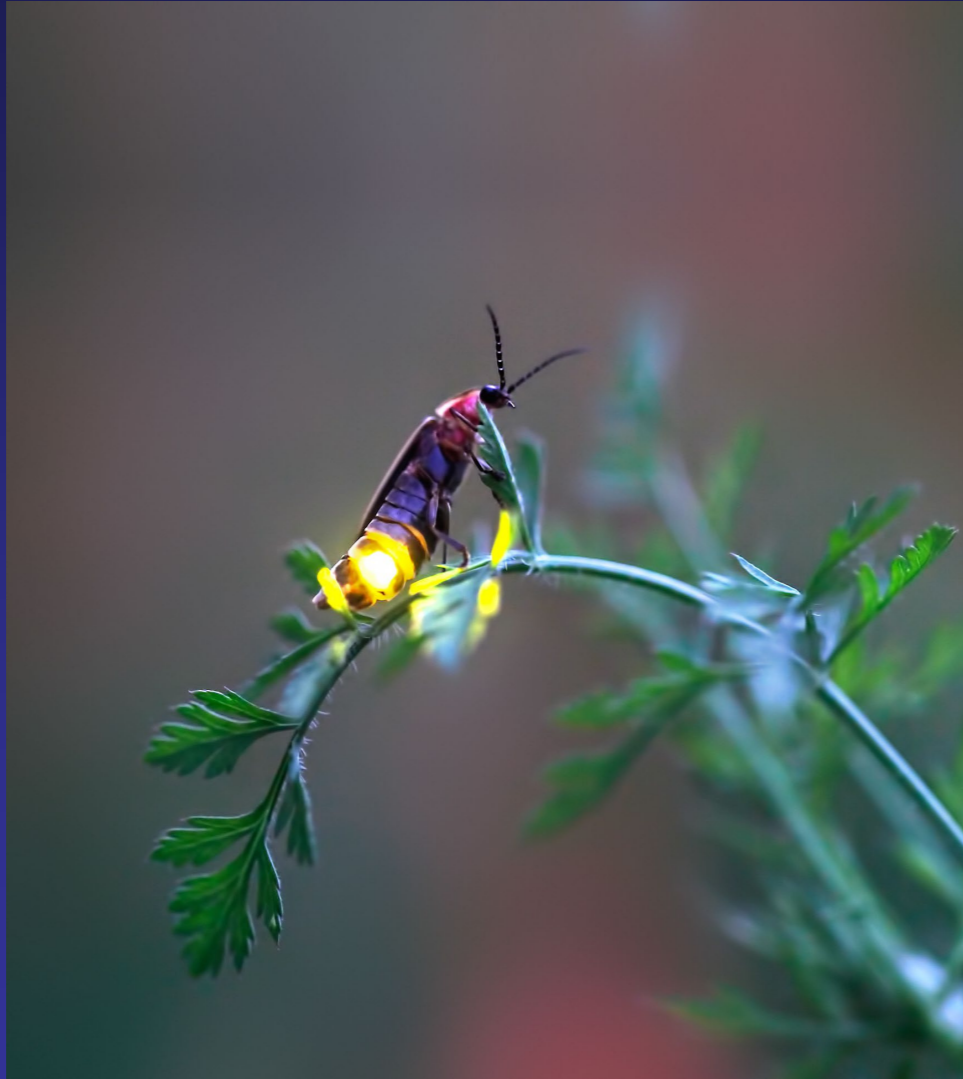
George Fleenor

Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**
- **Environmental consequences**



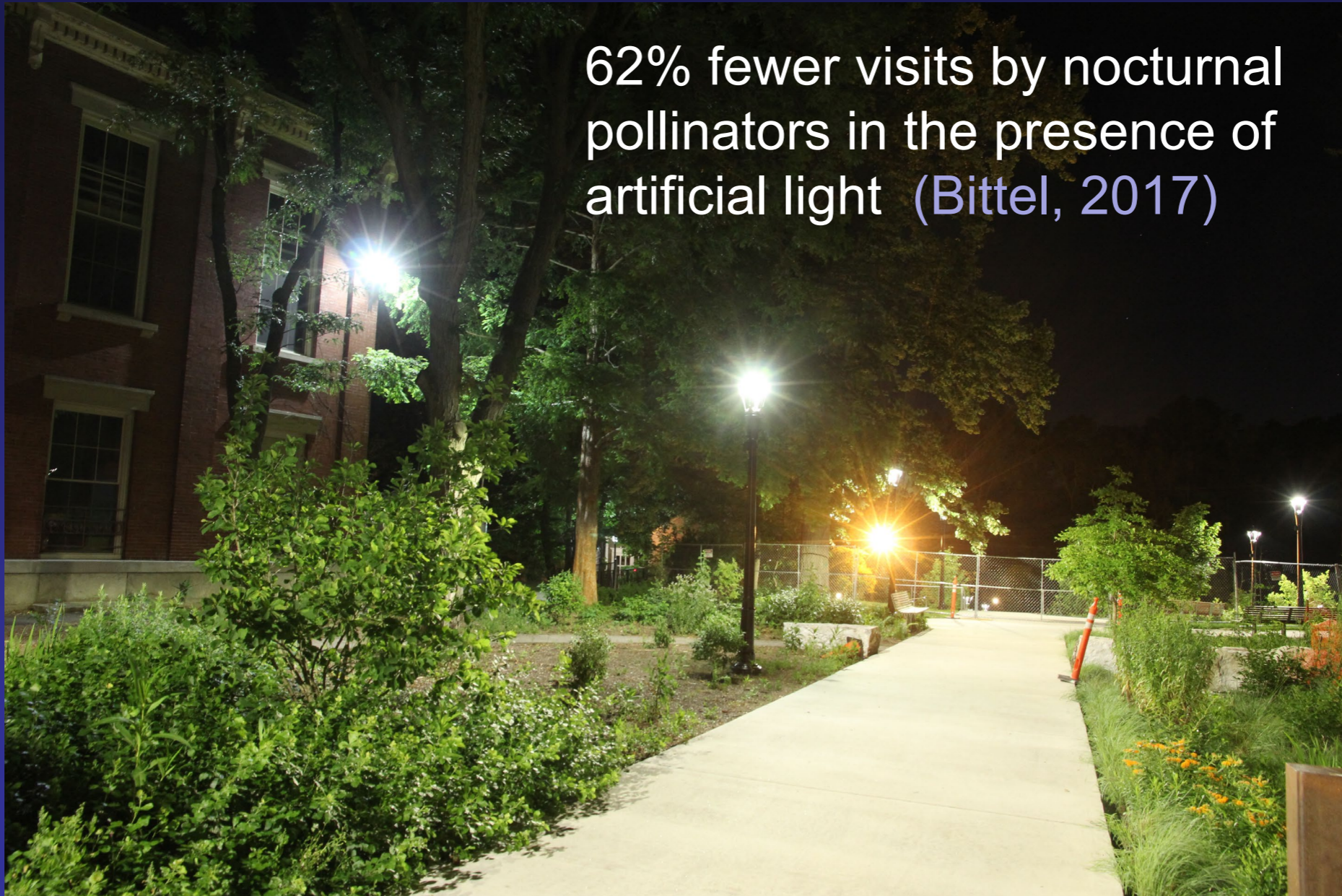
Light's Effects on Fireflies



Radim Schreiber

Light's Effects on Nocturnal Pollinators

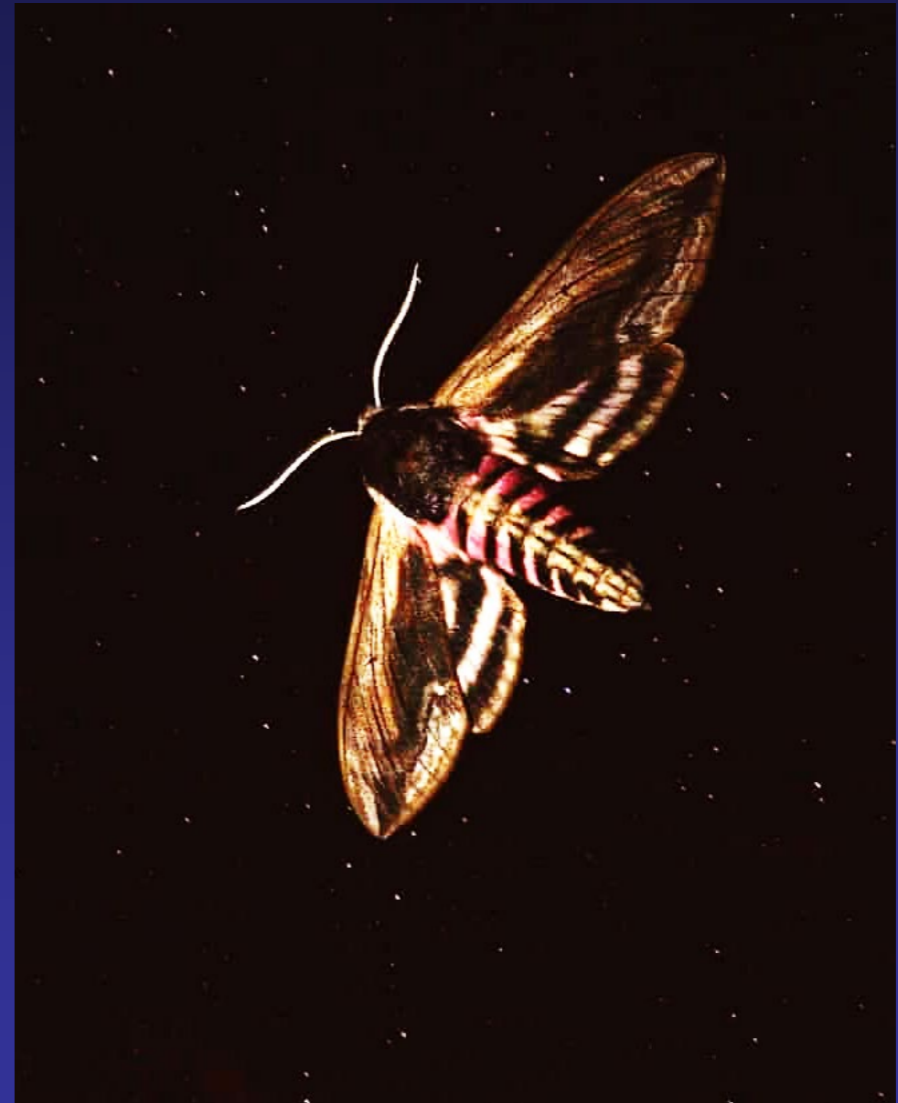
62% fewer visits by nocturnal pollinators in the presence of artificial light (Bittel, 2017)



Light's Role in the Insect Apocalypse

Worldwide, insect populations have **declined by 75%** in the past 50 years.

Some estimates suggest that **one third of insects** attracted to stationary artificial light sources **die before morning**, either through exhaustion or predation.



Light's Effects on Bird Migration

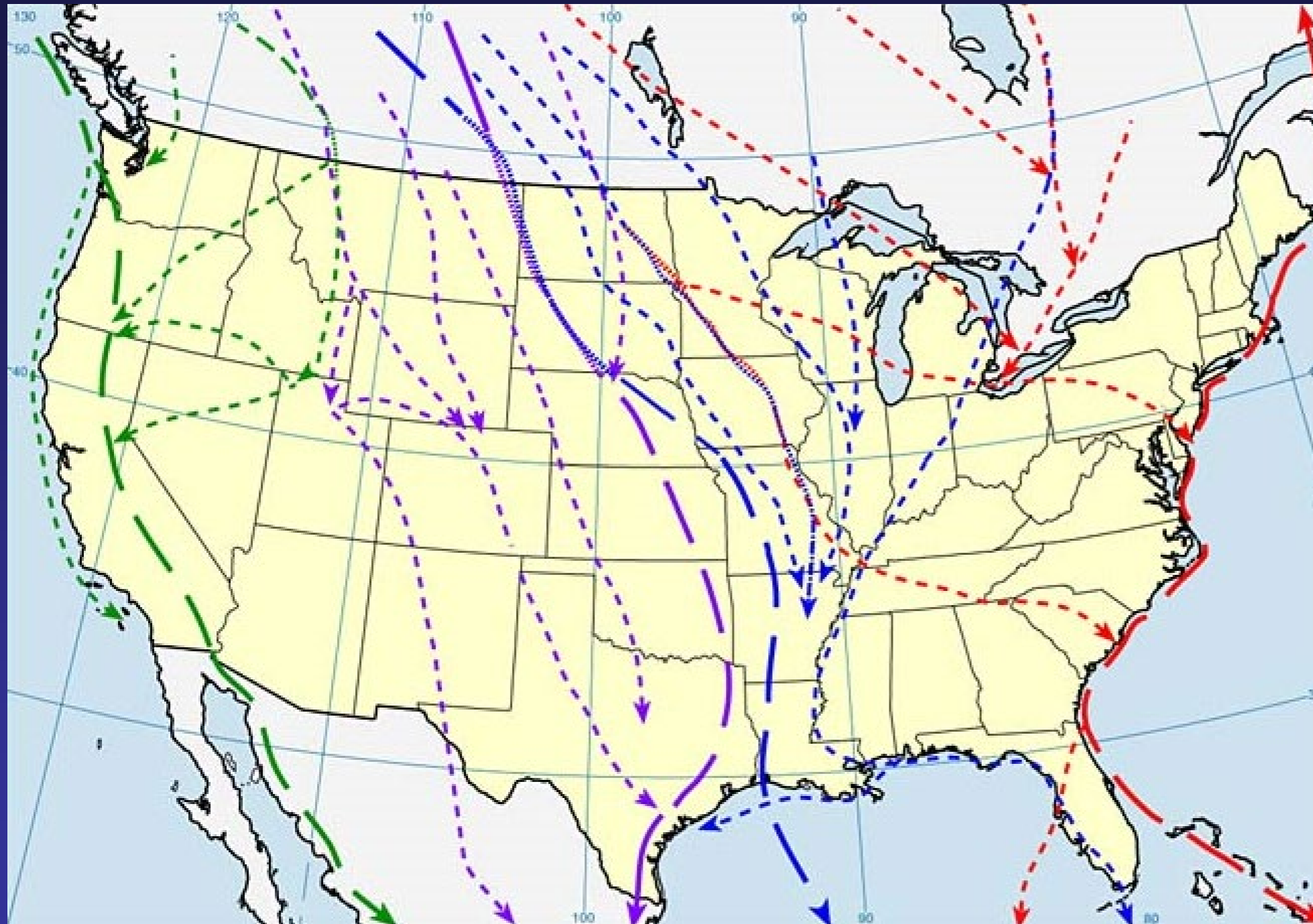


80% of migrating birds do so at night;
many or most use stars to navigate

What if they can't see the stars?

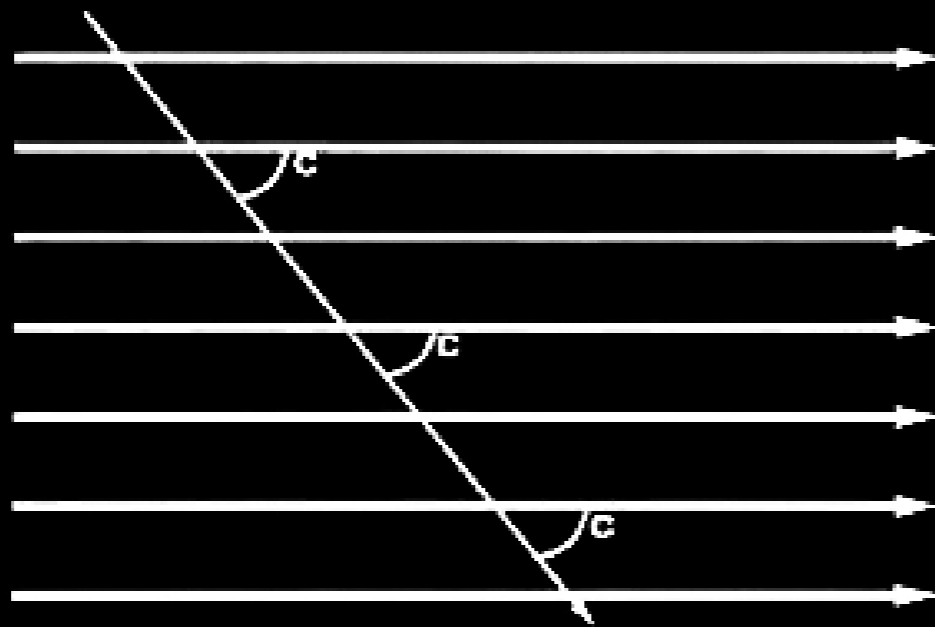


Bird Migratory Flyways



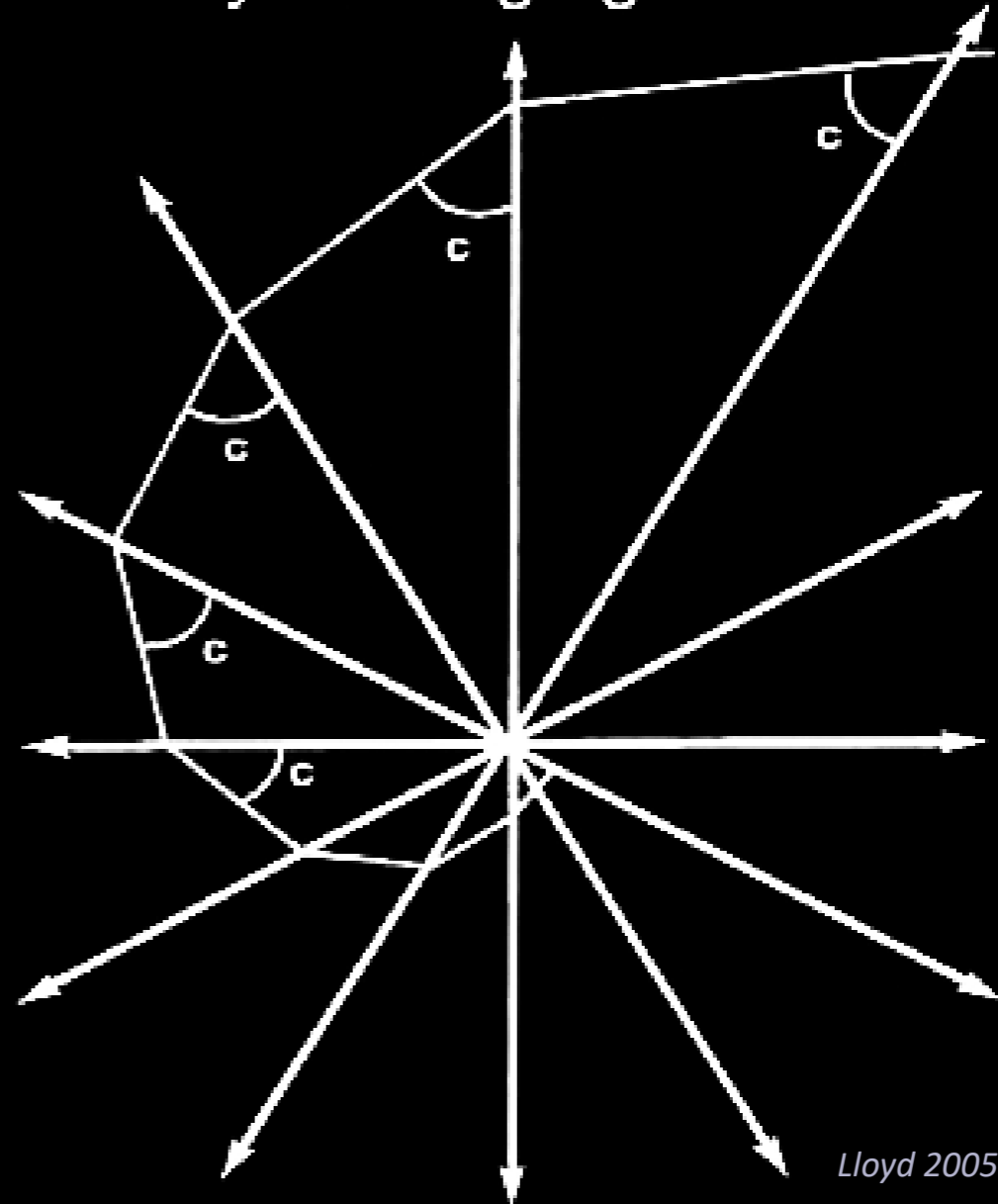
- Atlantic
- Mississippi
- Central
- Pacific

(a) Moonlight, at infinity
rays "parallel"



C= compass factor

(b) Streetlight, local
rays diverging



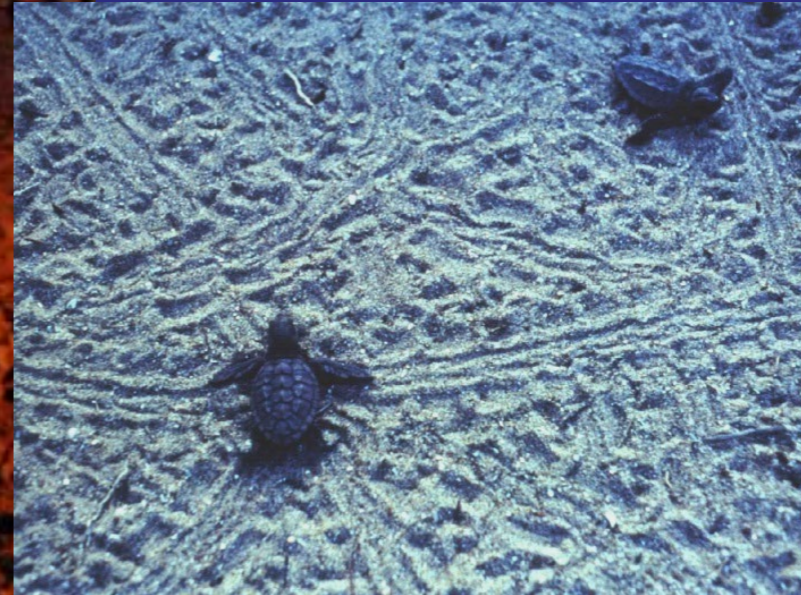
Lloyd 2005



Fatal Light Awareness Program

Artificial light contributes to an estimated **600 million bird deaths annually** from building collisions in the United States alone. (Loss & others, 2014)

Light's Effects on Sea Turtle Hatchlings



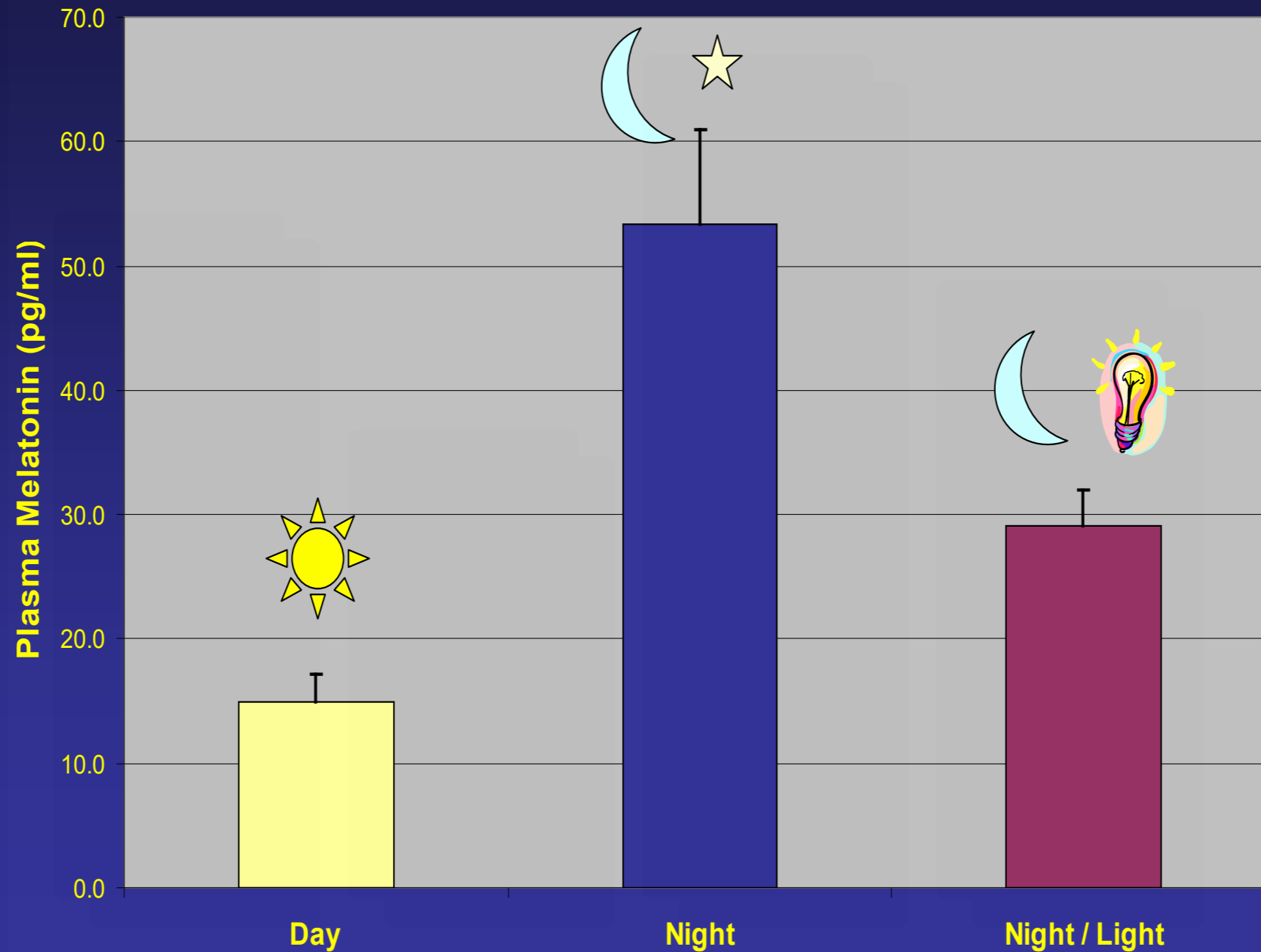
Light's Effects on Sea Turtle Hatchlings



Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**
- **Environmental consequences**
- **Human consequences**

Human Blood Plasma Melatonin Levels

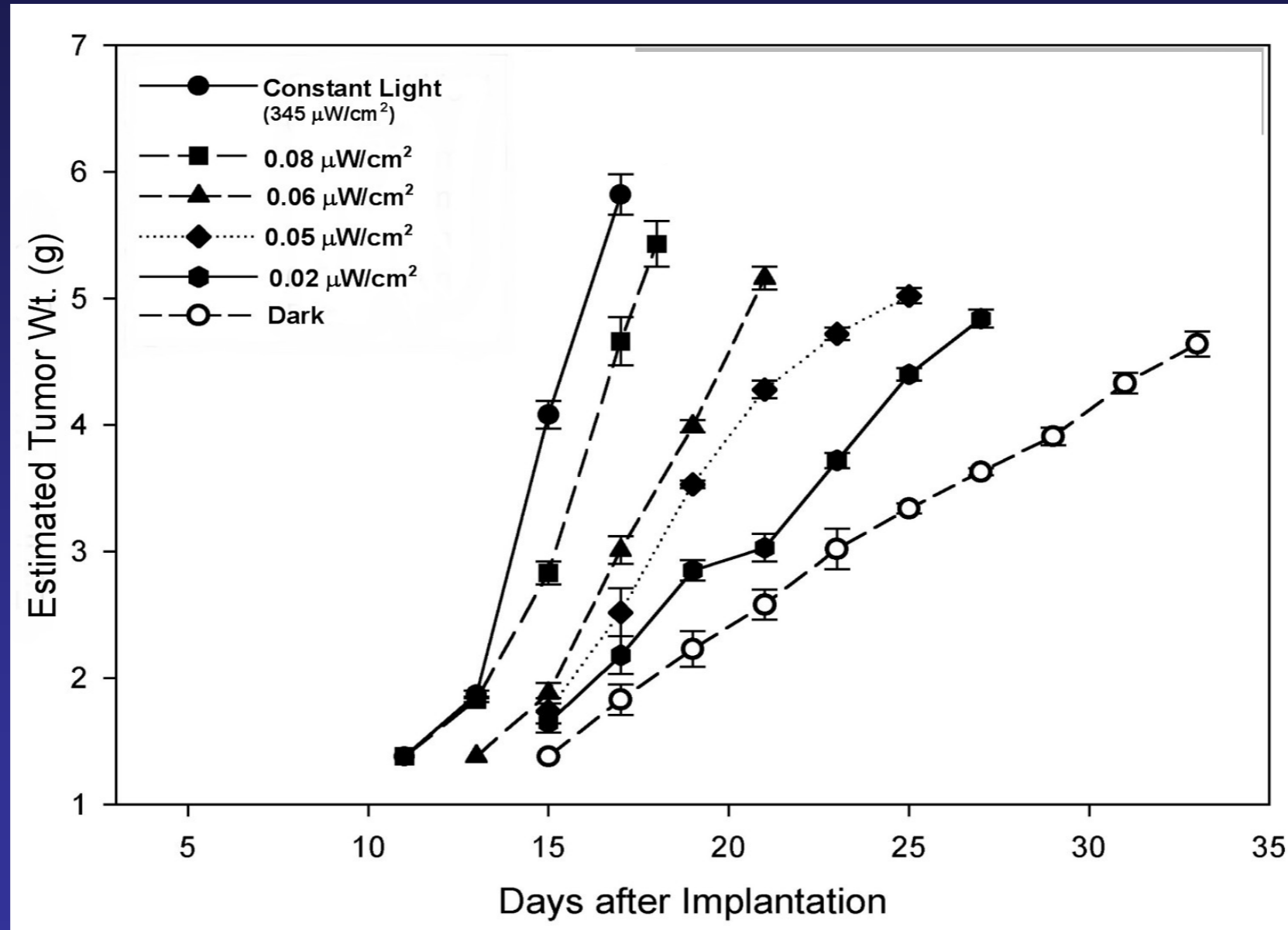


Light-at-Night Hypothesis

Richard G. Stevens, *Amer. J. Epidemiology* (1987)

Exposure to light at night suppresses pineal-gland melatonin production, which may explain some of the high and unaccounted for risk of breast cancer in industrialized 24-hr/day societies (shift work & fat intake at night).

Breast Cancer Growth Rates vs. Light Intensity



International Agency for Research on Cancer (May 2007):

“Shiftwork that involves circadian disruption is probably carcinogenic to humans.”



American Medical Association (June 2012):

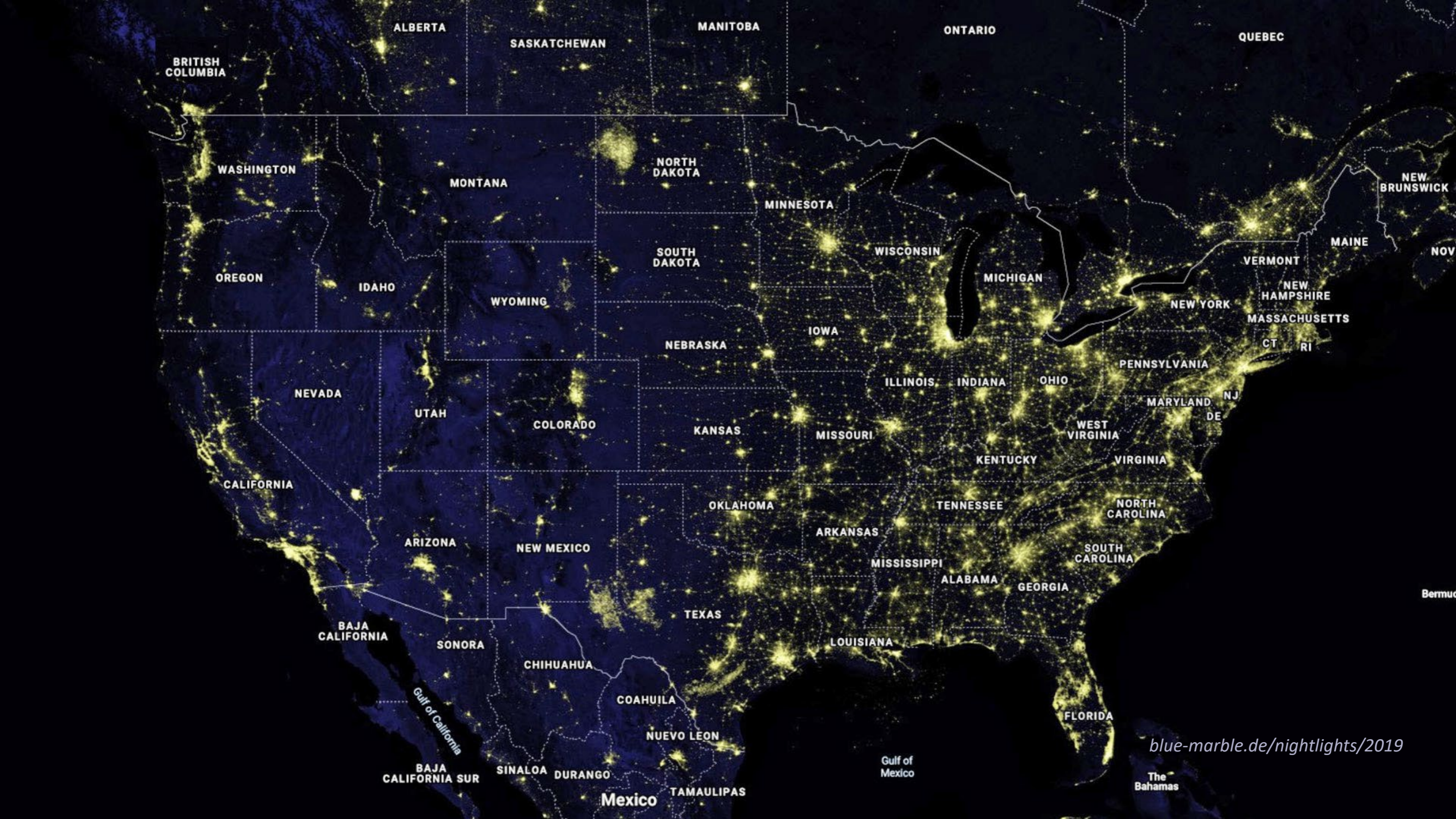
“Pervasive use of nighttime lighting disrupts various biological processes, creating potentially harmful health effects related to disability glare and sleep disturbance.”



Consequences of Light Pollution

- **Loss of the starry sky (skyglow)**
- **Visual impairment (glare, trespass)**
- **Environmental consequences**
- **Human consequences**
- **Energy waste**





ALBERTA SASKATCHEWAN MANITOBA ONTARIO QUEBEC
BRITISH COLUMBIA
WASHINGTON MONTANA NORTH DAKOTA
OREGON IDAHO WYOMING SOUTH DAKOTA MINNESOTA
NEVADA UTAH COLORADO KANSAS IOWA WISCONSIN MICHIGAN
CALIFORNIA ARIZONA NEW MEXICO OKLAHOMA MISSOURI ILLINOIS INDIANA OHIO PENNSYLVANIA
BAJA CALIFORNIA SONORA CHIHUAHUA COAHUILA NUEVO LEÓN TEXAS ARKANSAS MISSISSIPPI ALABAMA GEORGIA NORTH CAROLINA SOUTH CAROLINA
BAJA CALIFORNIA SUR SINALOA DURANGO TAMAULIPAS MEXICO
Gulf of California Gulf of Mexico
NEW BRUNSWICK MAINE VERMONT NEW HAMPSHIRE MASSACHUSETTS CT RI NJ DE
The Bahamas

blue-marble.de/nightlights/2019

LIGHT POLLUTION

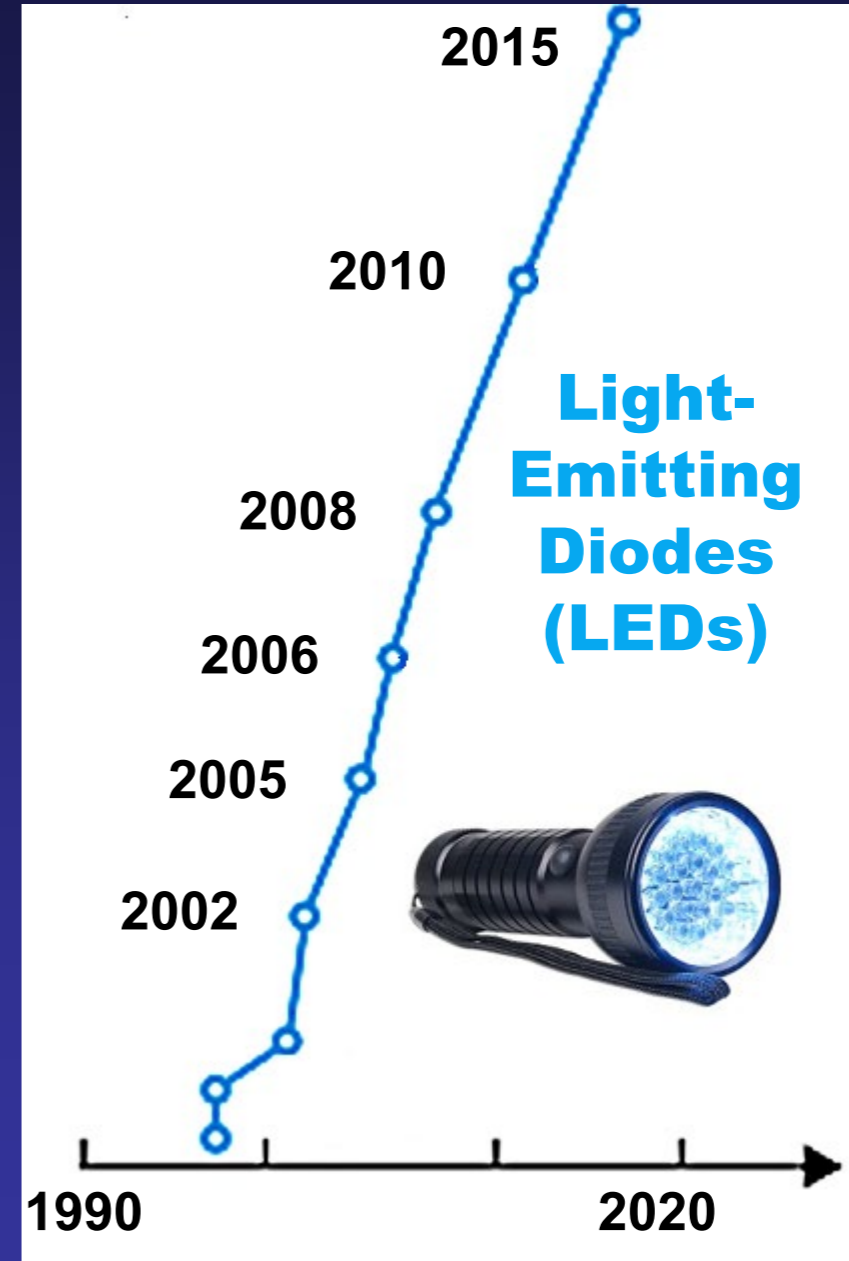
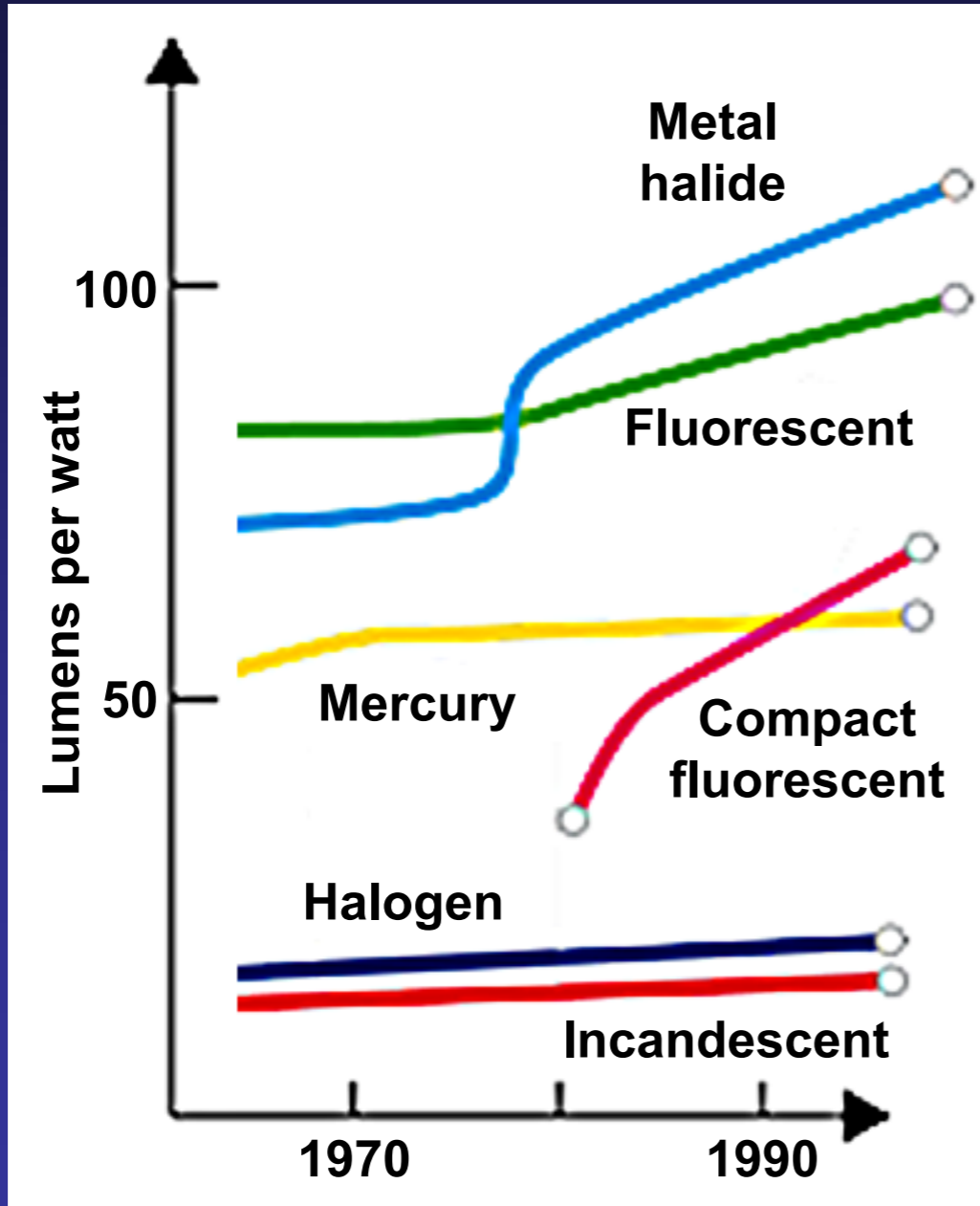
Citizen scientists report global rapid reductions in the visibility of stars from 2011 to 2022

Christopher C. M. Kyba,^{1,2*} Yiğit Öner Altıntaş,^{1†} Constance E. Walker,³ Mark Newhouse⁴

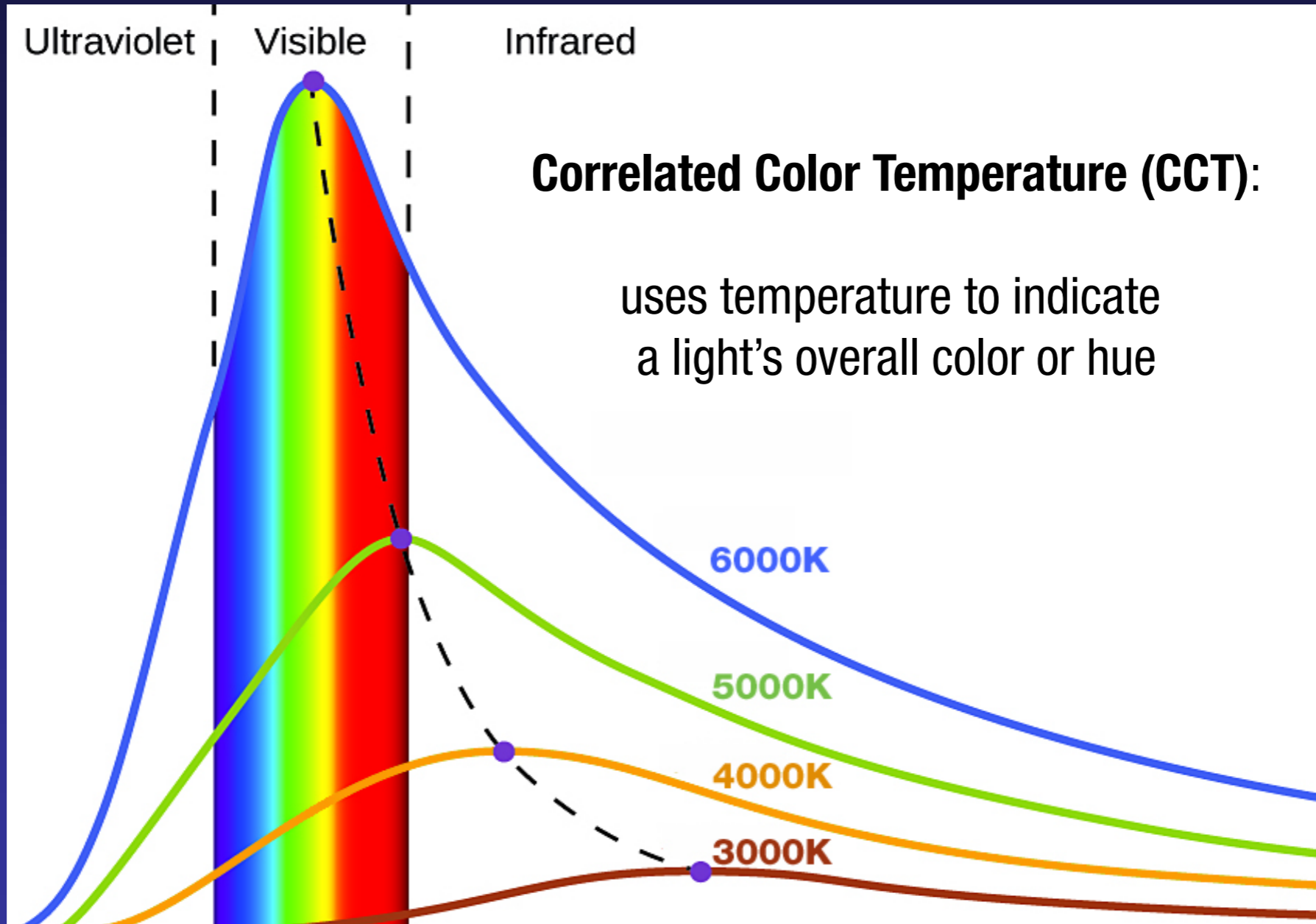
The artificial glow of the night sky is a form of light pollution; its global change over time is not well known. Developments in lighting technology complicate any measurement because of changes in lighting practice and emission spectra. We investigated the change in global sky brightness from 2011 to 2022 using 51,351 citizen scientist observations of naked-eye stellar visibility. The number of visible stars decreased by an amount that can be explained by an increase in sky brightness of 7 to 10% per year in the human visible band. This increase is faster than emissions changes indicated by satellite observations. We ascribe this difference to spectral changes in light emission and to the average angle of light emissions.

The Promise of LEDs

250+ lm/w



What is “Color Temperature”?



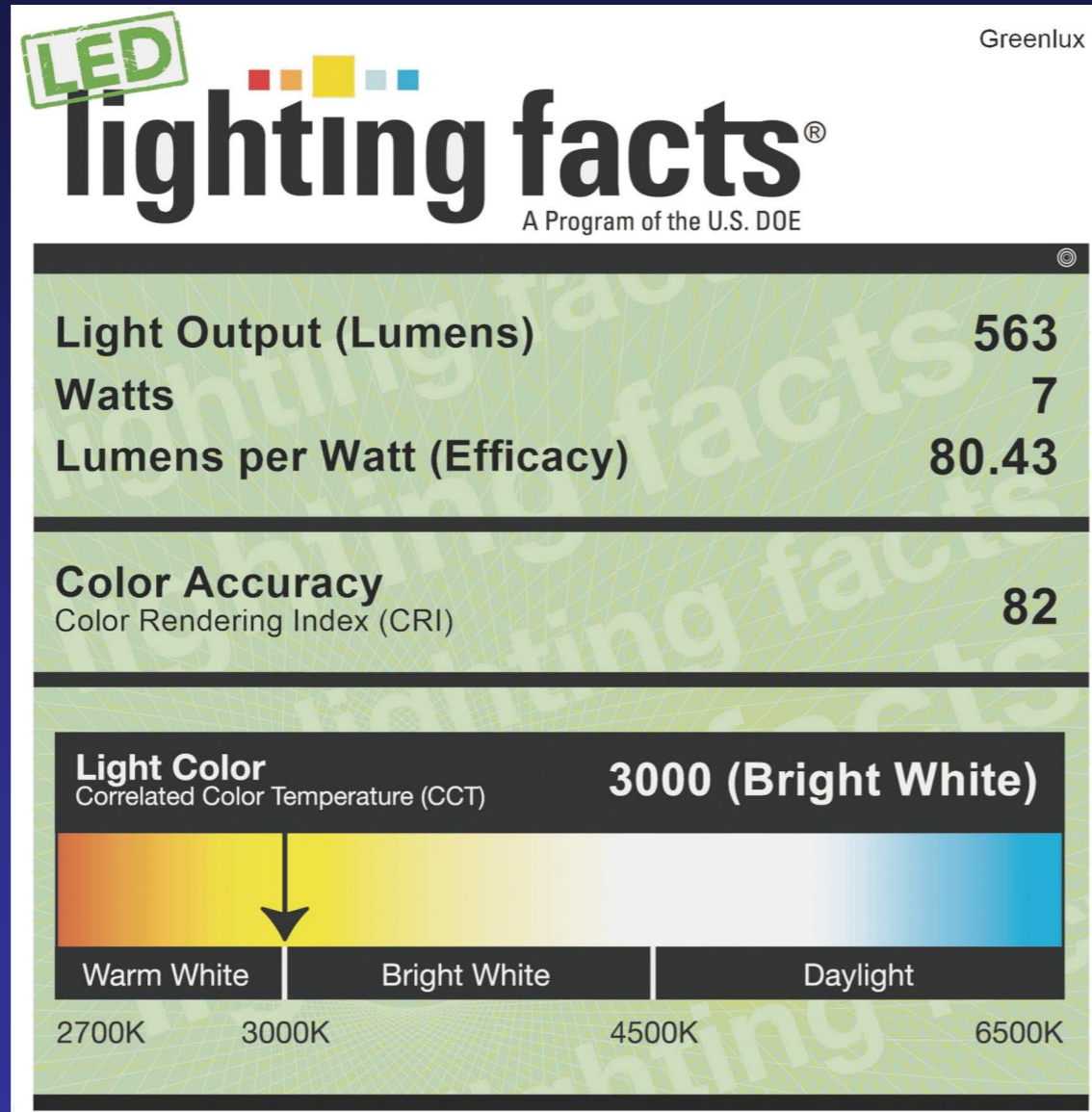
What is “Color Temperature”?



**Correlated
Color
Temperature
(CCT):**

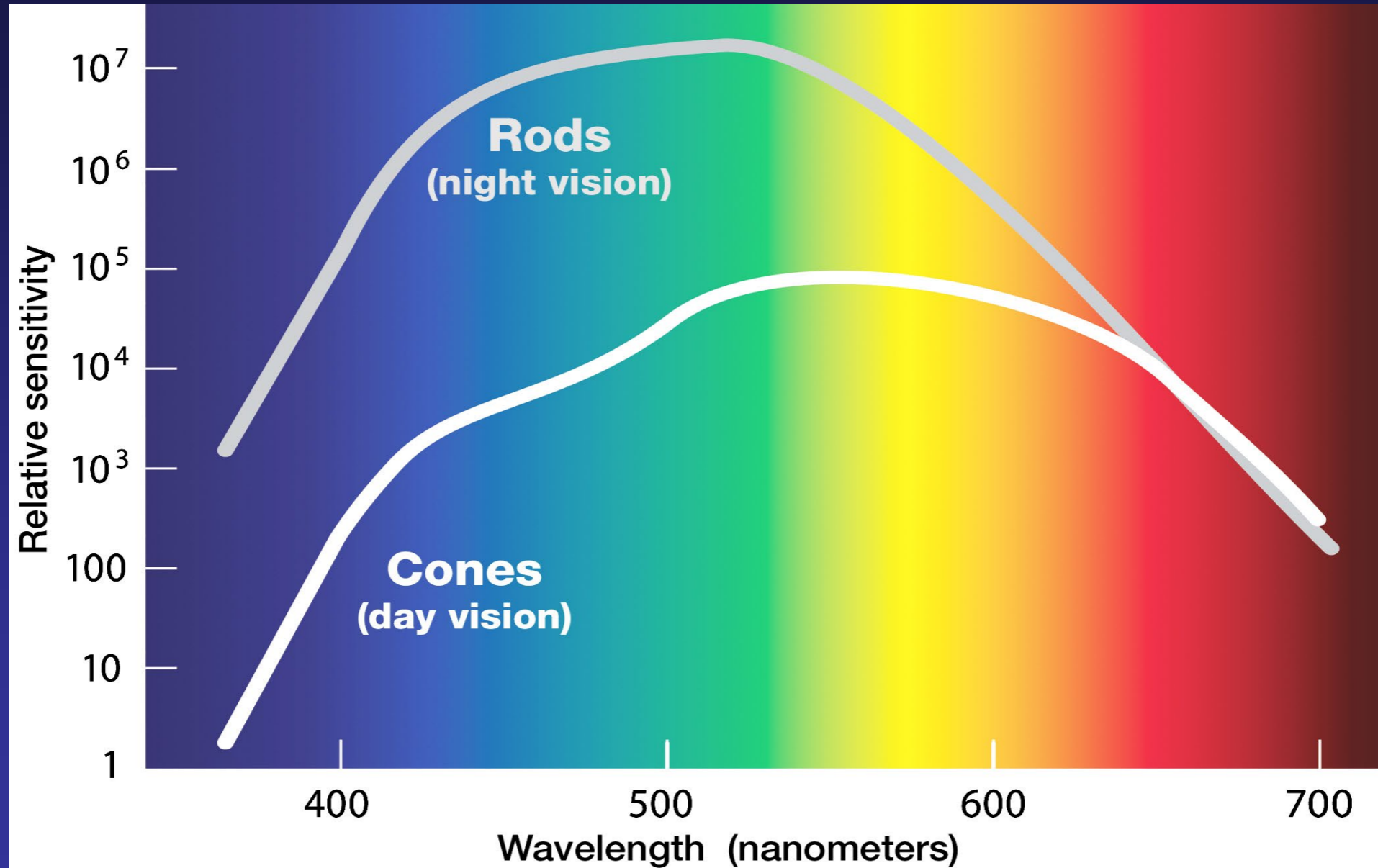
temperature
indicates a
light's overall
color or hue

What is “Color Temperature”?

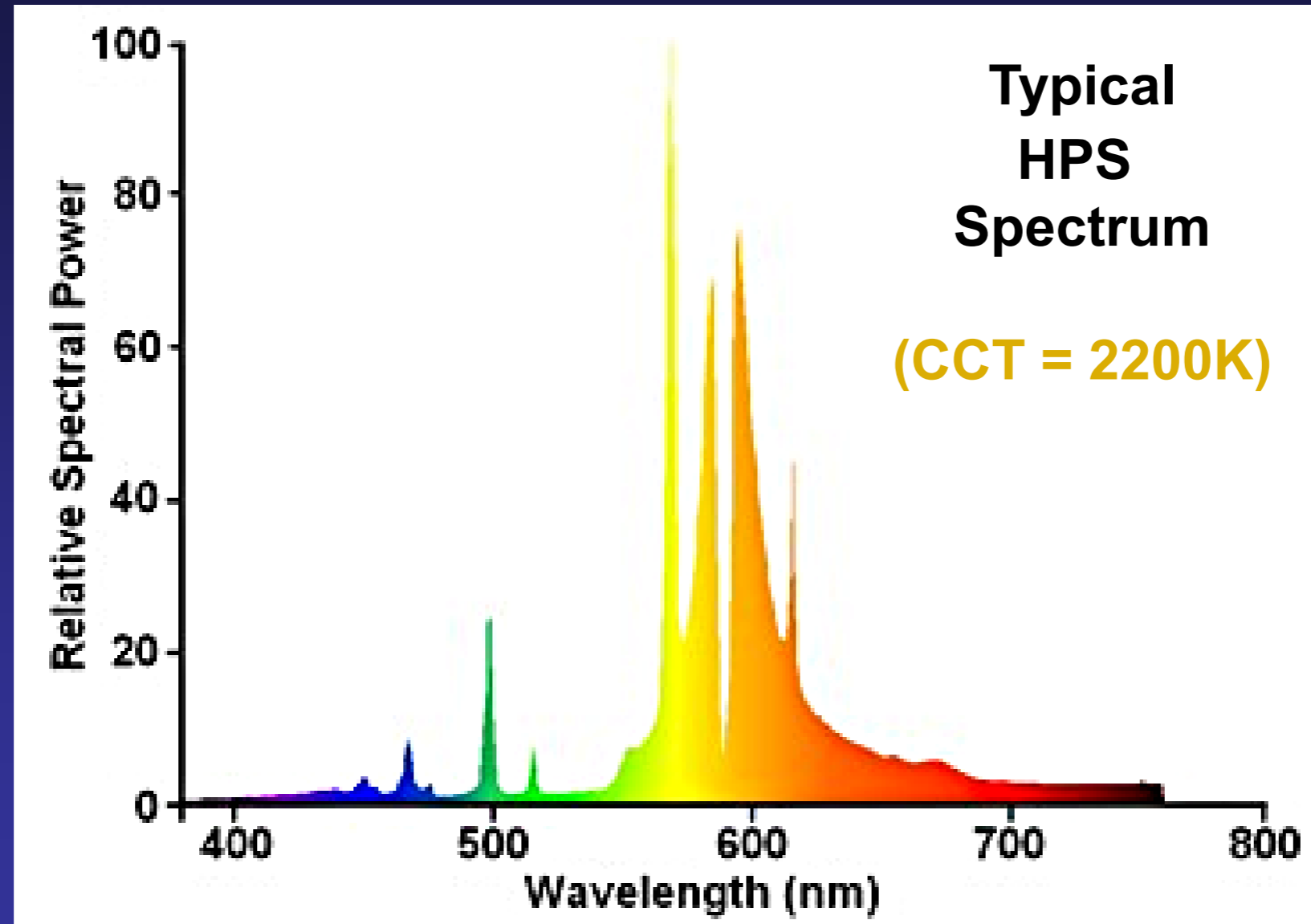


**CCT is now
listed on
bulb labels**

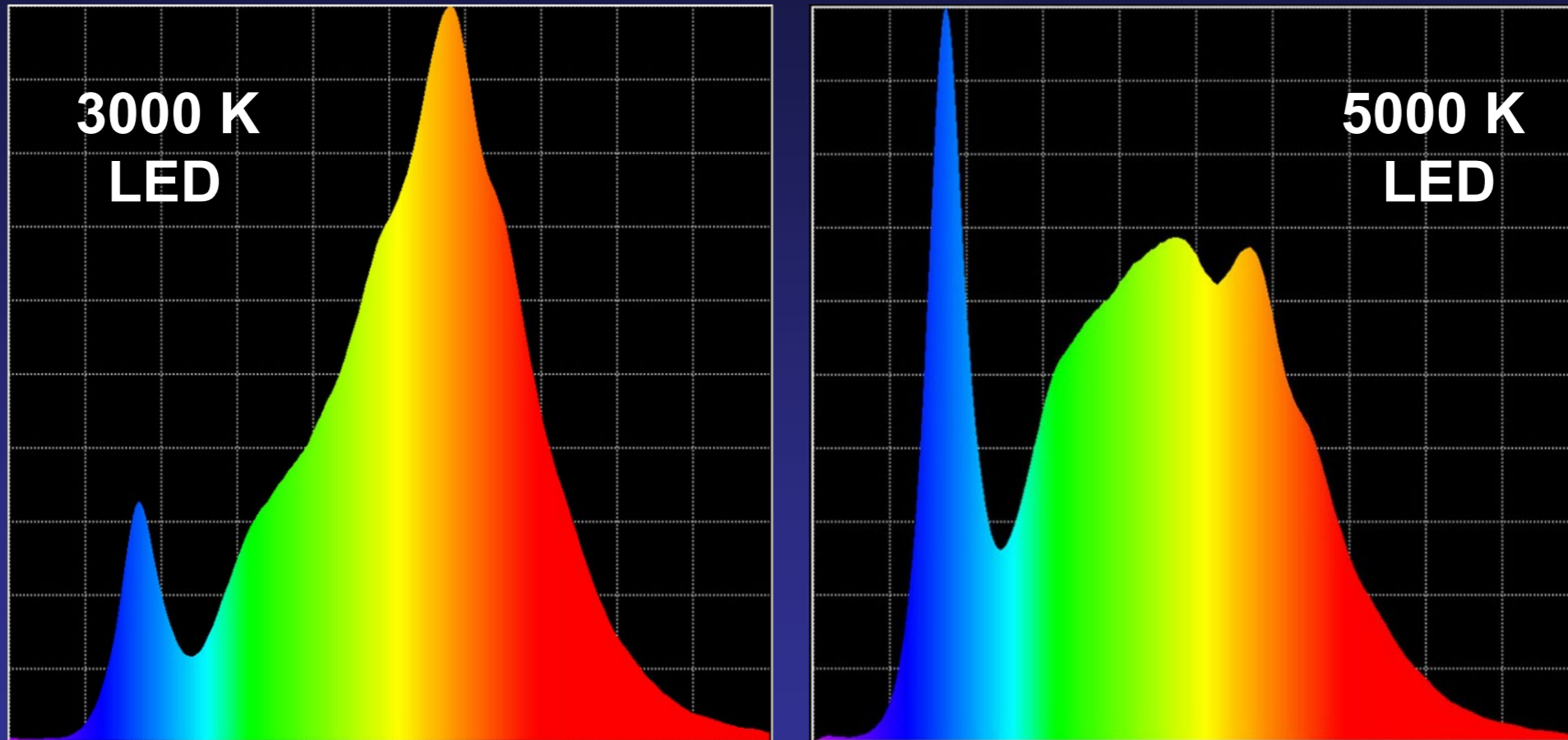
A Caution About LEDs



A Caution About LEDs

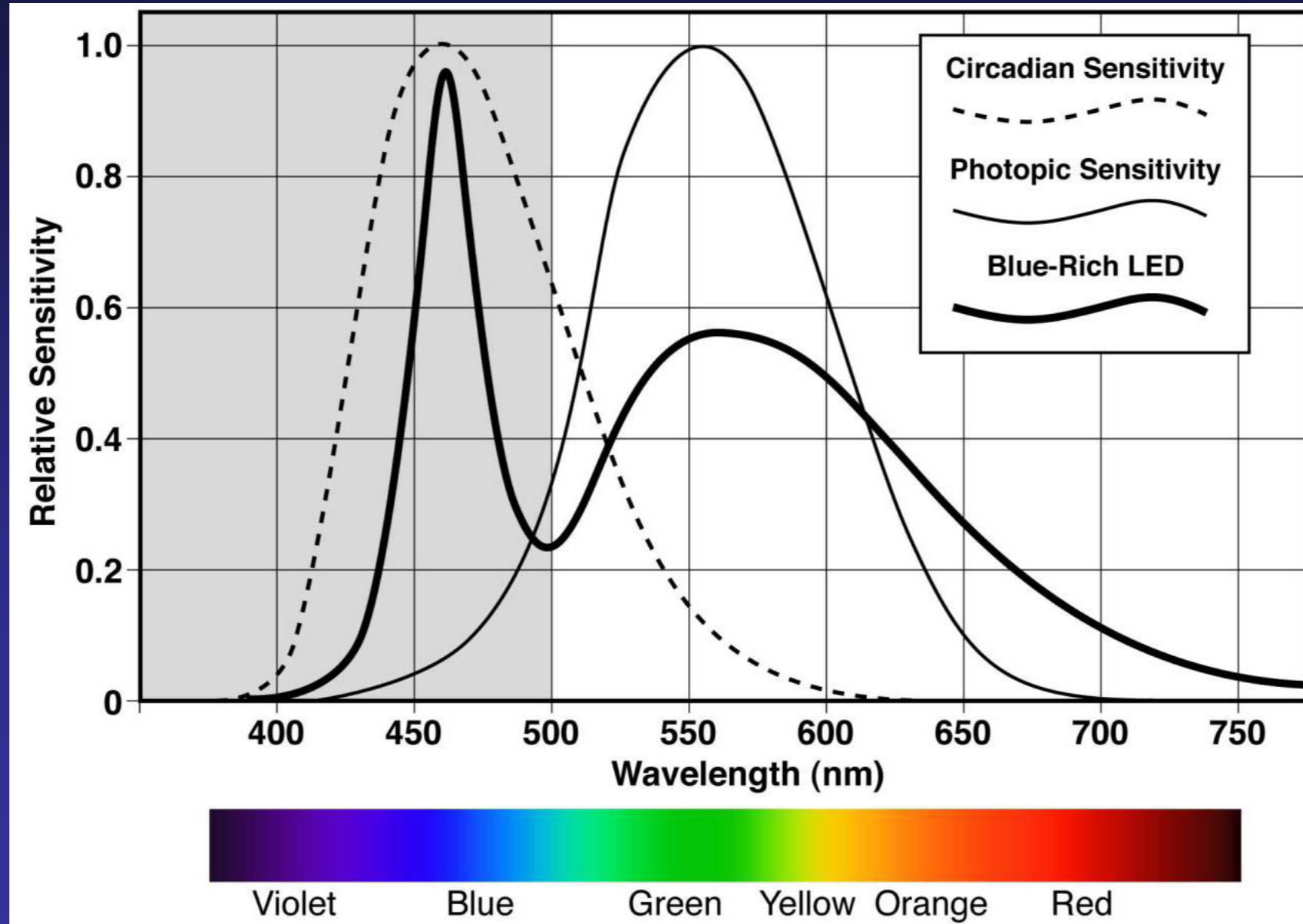


A Caution About LEDs



LED streetlights typically create much more blue light than the HPS fixtures they are replacing.

A Caution About LEDs



LED Streetlights, Cambridge, MA



American Medical Association (June 2016):

“AMA encourage[s] the use of 3000K or lower lighting for outdoor installations such as roadways.”



Streetlight Test



Pepperell, MA



2200K LED

Less glare

Lower cost

Favored by citizens

Better coverage

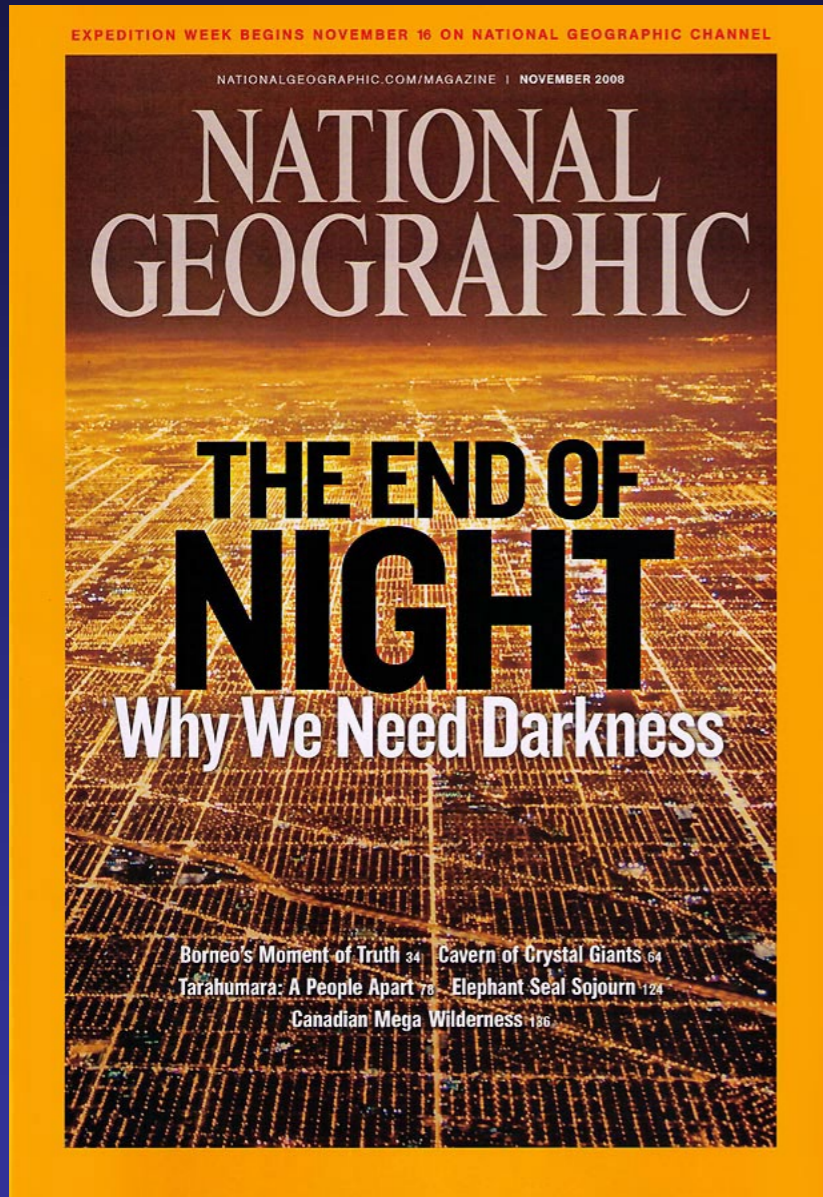
2200K HPS

More glare

Higher cost

Worse coverage

Growing Awareness



New York Times

“Stop Ruining Starry Nights” (July 2022)

New York Times

IDSP feature article (Feb. 2022)

Boston Globe

“Stolen Starlight” (Aug. 2021)

CBS This Morning

Aug. 2015, Aug. 2016

National Geographic

Nov. 2008 cover story

Lighting Fundamentals: “Five Principles”

(IDA-IES partnership announced April 2020)

USEFUL

All light should have a clear purpose

TARGETED

Light should be directed only to where needed

LOW LEVELS

Light should be no brighter than necessary

CONTROLLED

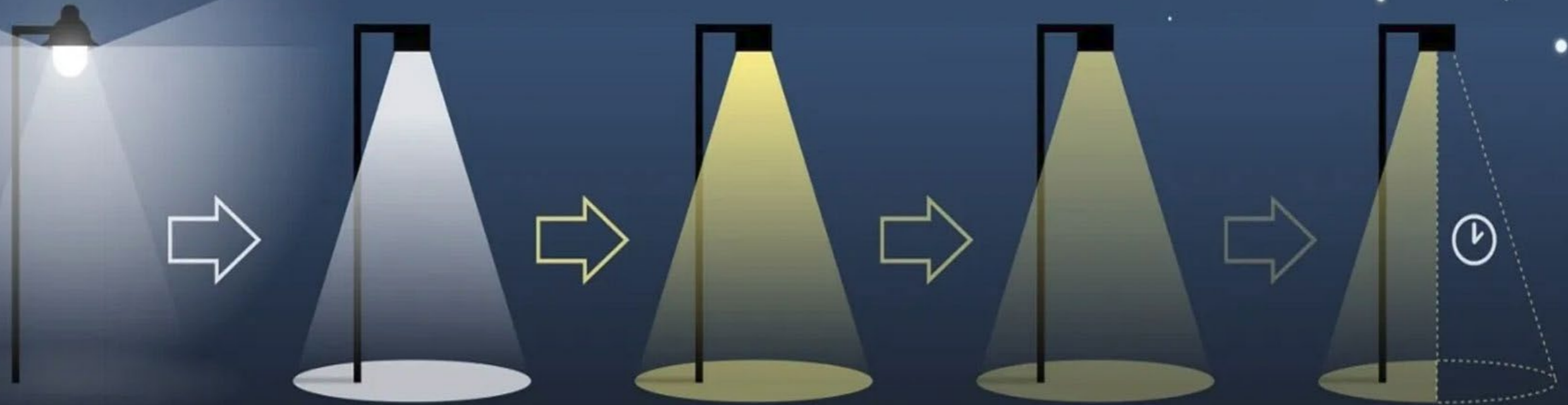
Light should be used only when it is useful

COLOR

Use warmer color lights where possible

Lighting Fundamentals: “Five Principles”

(IDA-IES partnership announced April 2020)



Shielding

**Color
temperature**

Intensity

Timing

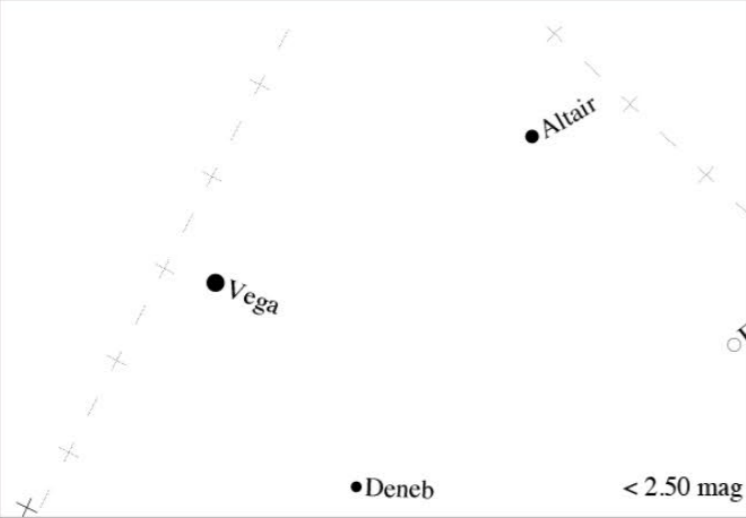
LIGHT POLLUTION

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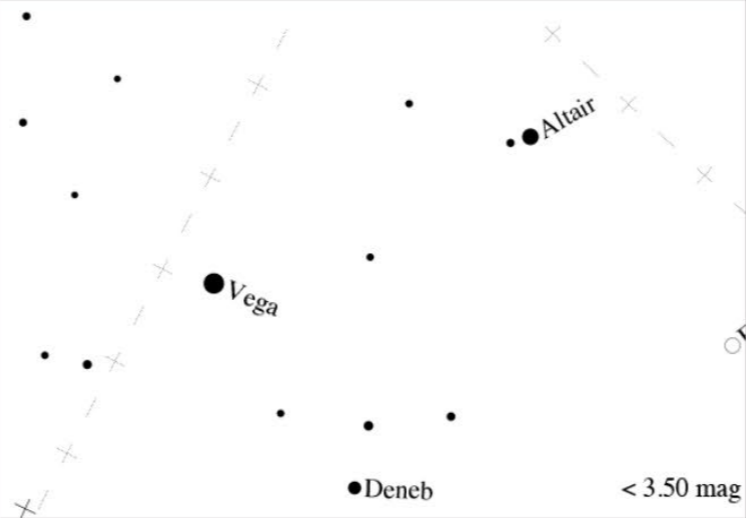
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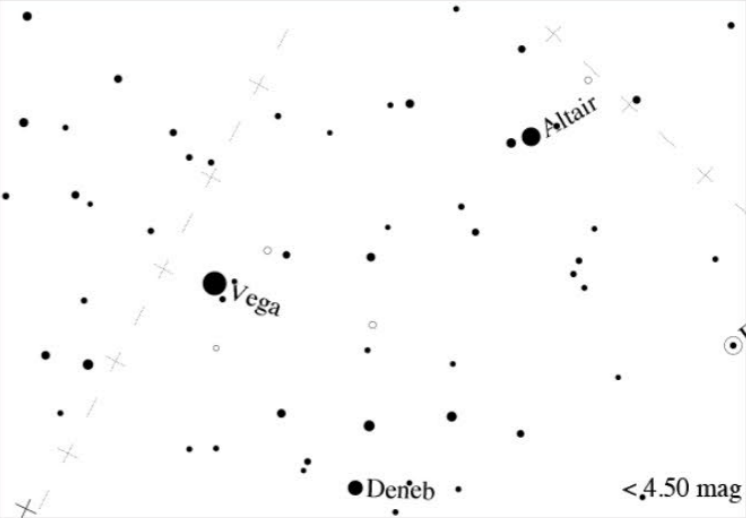
GlobeAtNight.org



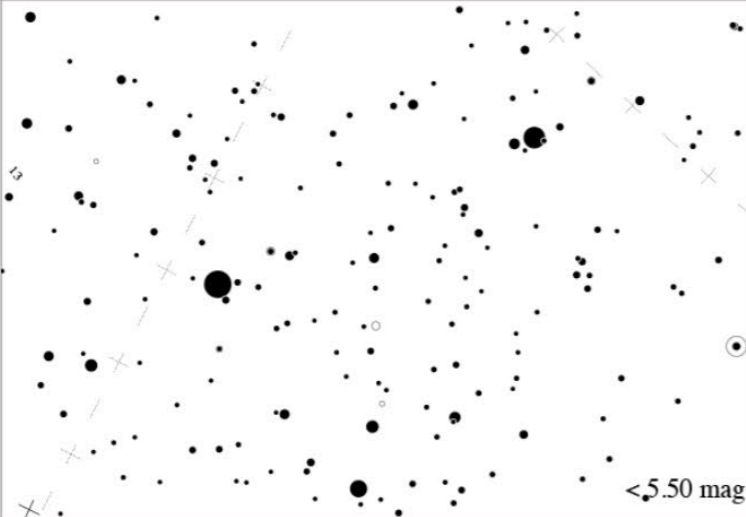
Magnitude 2



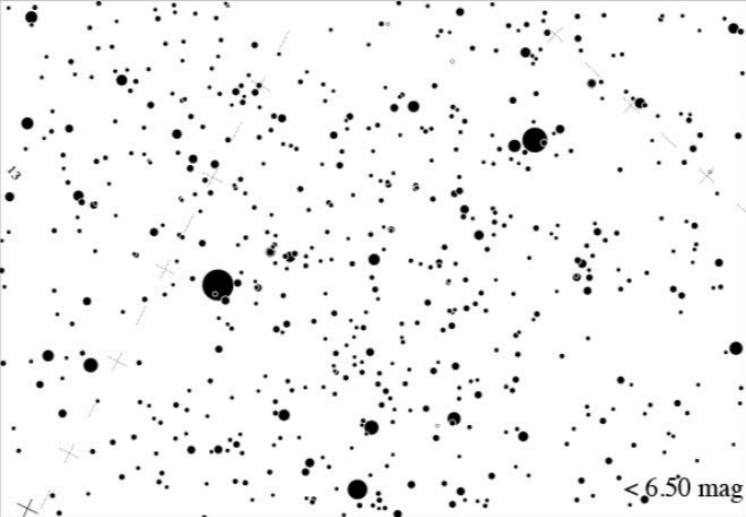
Magnitude 3



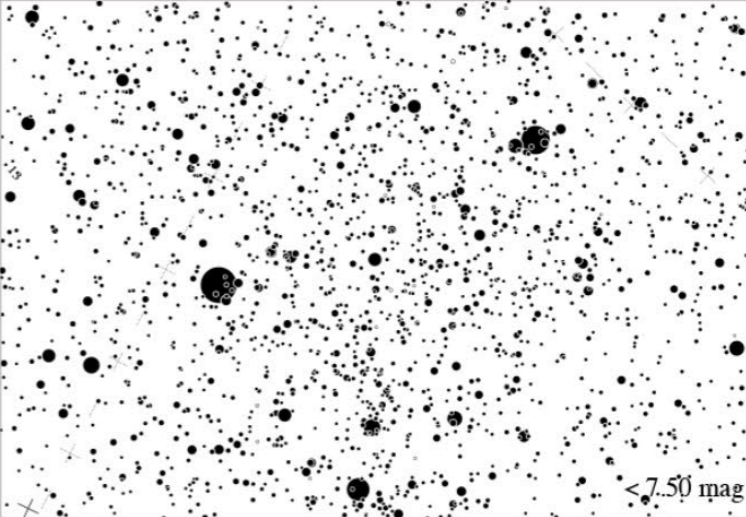
Magnitude 4



Magnitude 5



Magnitude 6



Magnitude 7

GlobeAtNight.org

1 When did you make your observations?

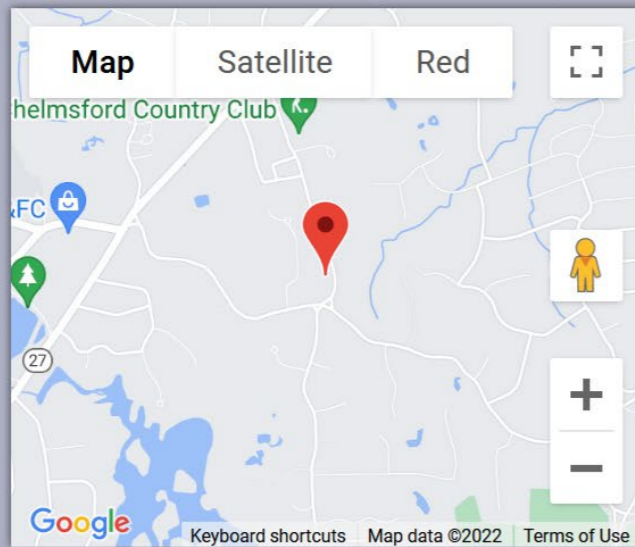
Observation Date
(yyyy/mm/dd) 2022/06/21

Observation Time
(24 hour time) 22:45

Switch to [Daytime version](#).

2 Where did you make your observations?

Map It!



Location correct:

Reset GPS

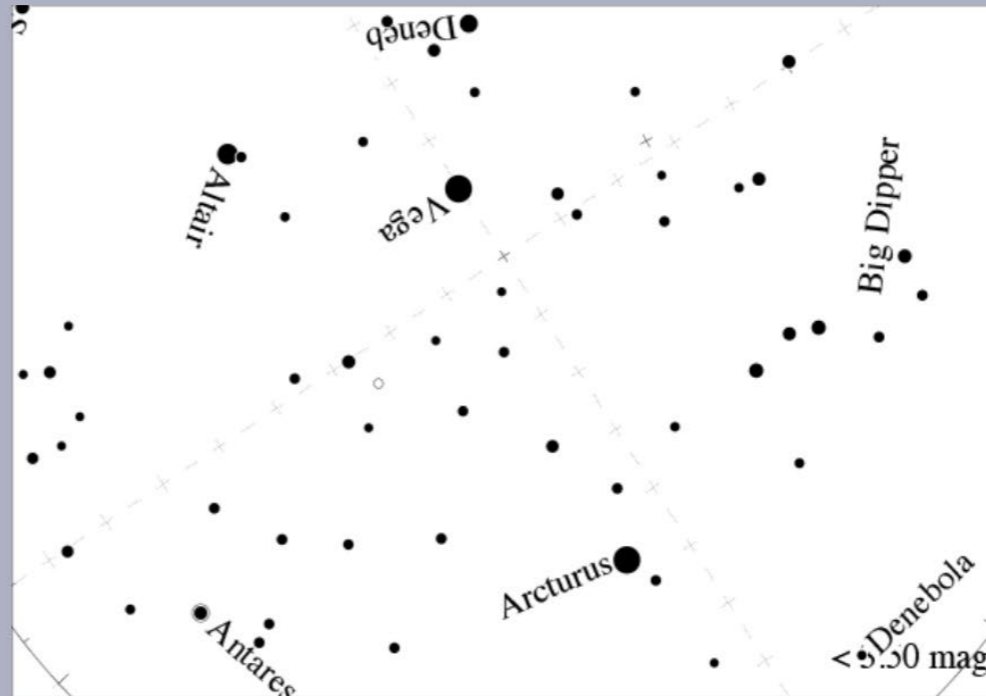
Latitude: 42.56962
Longitude: -71.3675665
Elevation: 68.77 meters

Country:

United States - Massachusetts

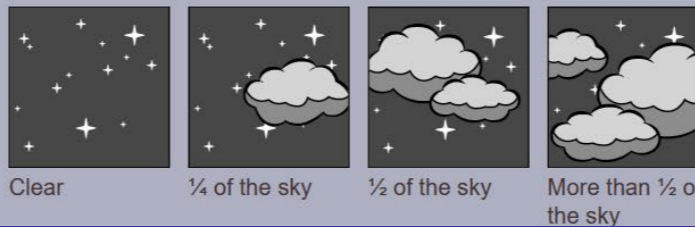
Location comments

3 How dark was the sky that night?



Constellation: Hercules

4 What were sky conditions like that night?



GlobeAtNight.org



SQM-L • \$155
uni-hedron.com

Lighting Fundamentals: The Task

Light when you need it,

where you need it,

in just the amount necessary . . .

Lighting Fundamentals: The Task

Light when you need it,

where you need it,

in just the amount necessary . . .

and no more. All else is waste.