Introduction to Lighting and Night Skies: City of Loveland Open Lands and Trails Advisory Commission

PRESENTED BY:

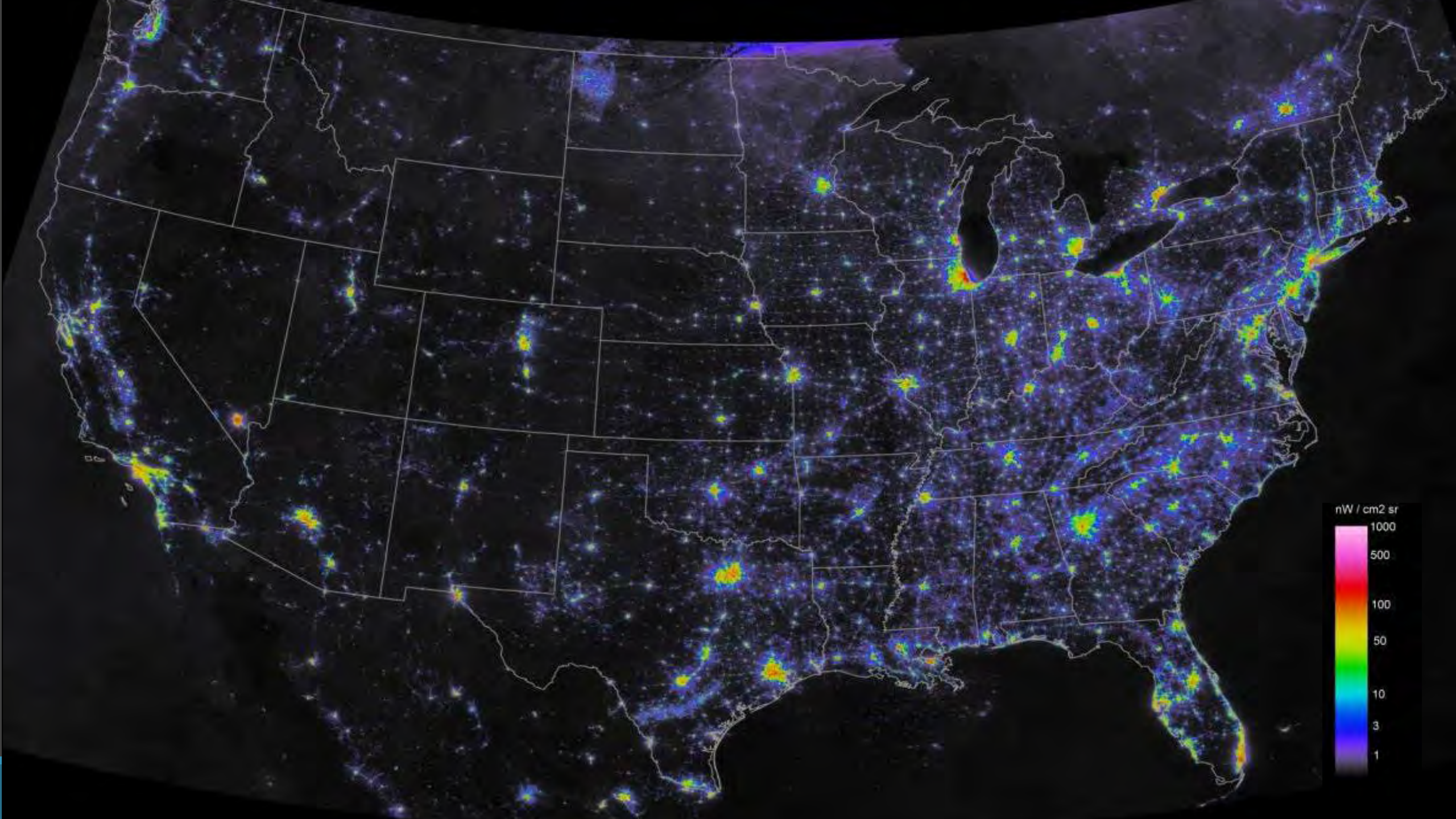
ADAM BEECO

The average night sky in Europe and North America became almost 10% brighter each year between 2011 and 2022

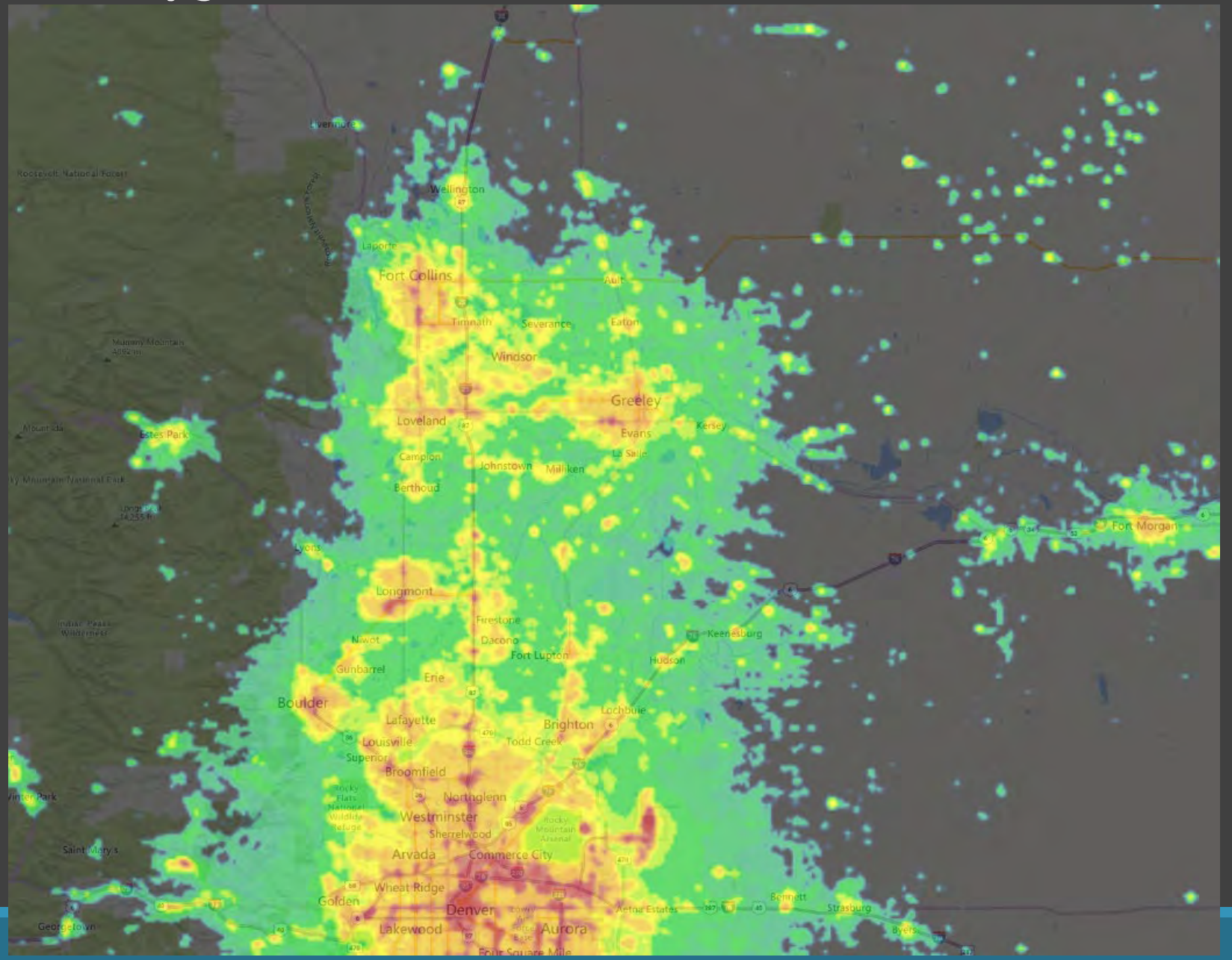
A global view of artificial light at night revealed 80% of the world's human population lives under light-polluted skies, with almost one quarter of the earth's land surface experiencing artificially elevated levels of sky brightness

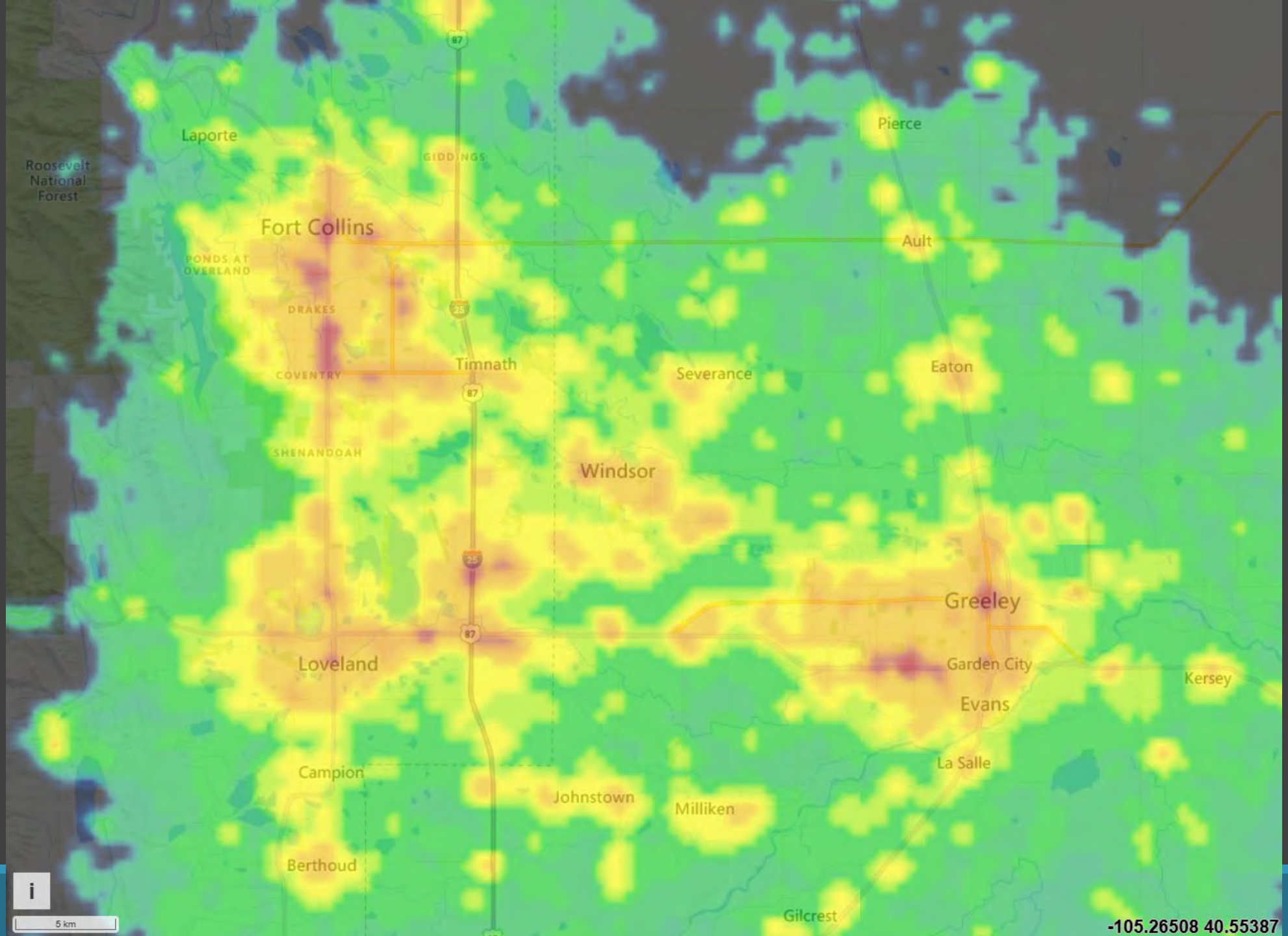
Globally, artificially lit surface area is increasing at a rate of 2% per year

Night as a Resource

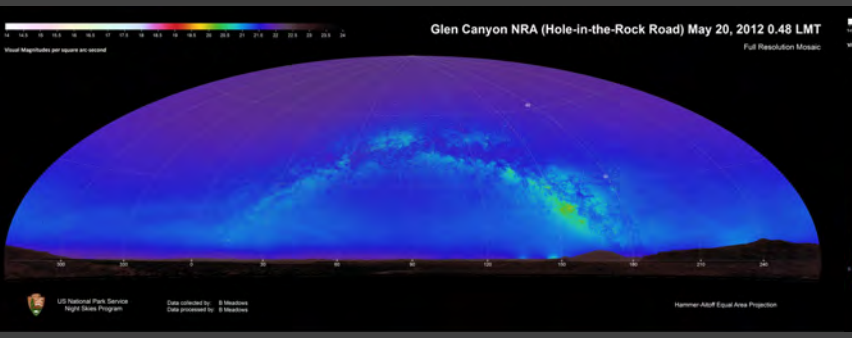

nW / cm2 sr
1000
500
100
50
10
3
1

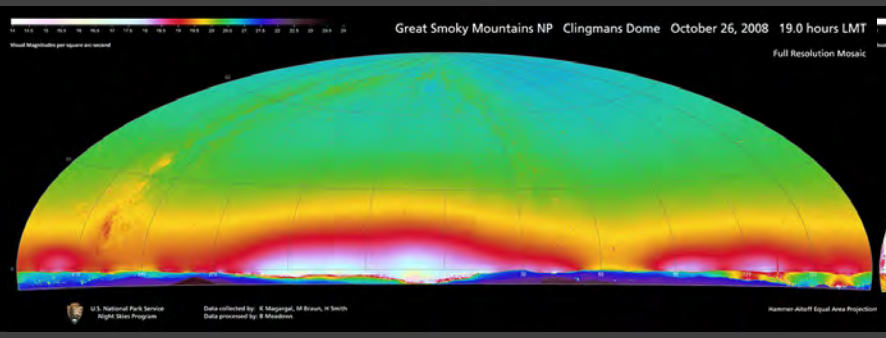
Landscape Scale Skyglow

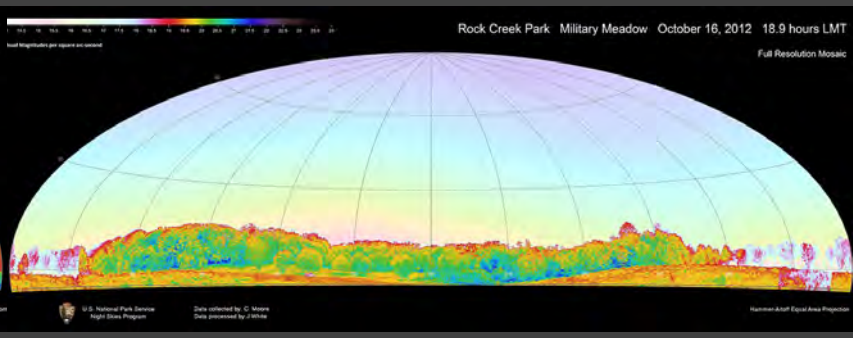



Laporte
Roosevelt National Forest
GIDDINGS
Pierce
Fort Collins
PONDS AT OVERLAND
Ault
DRAKES
COVENTRY
Timnath
Severance
Eaton
SHENANDOAH
Windsor
Greeley
Loveland
Garden City
Kersey
Evans
La Salle
Campion
Johnstown
Milliken
Berthoud
Gilcrest
i
5 km
-105.26508 40.55387

Diminished Natural Cues





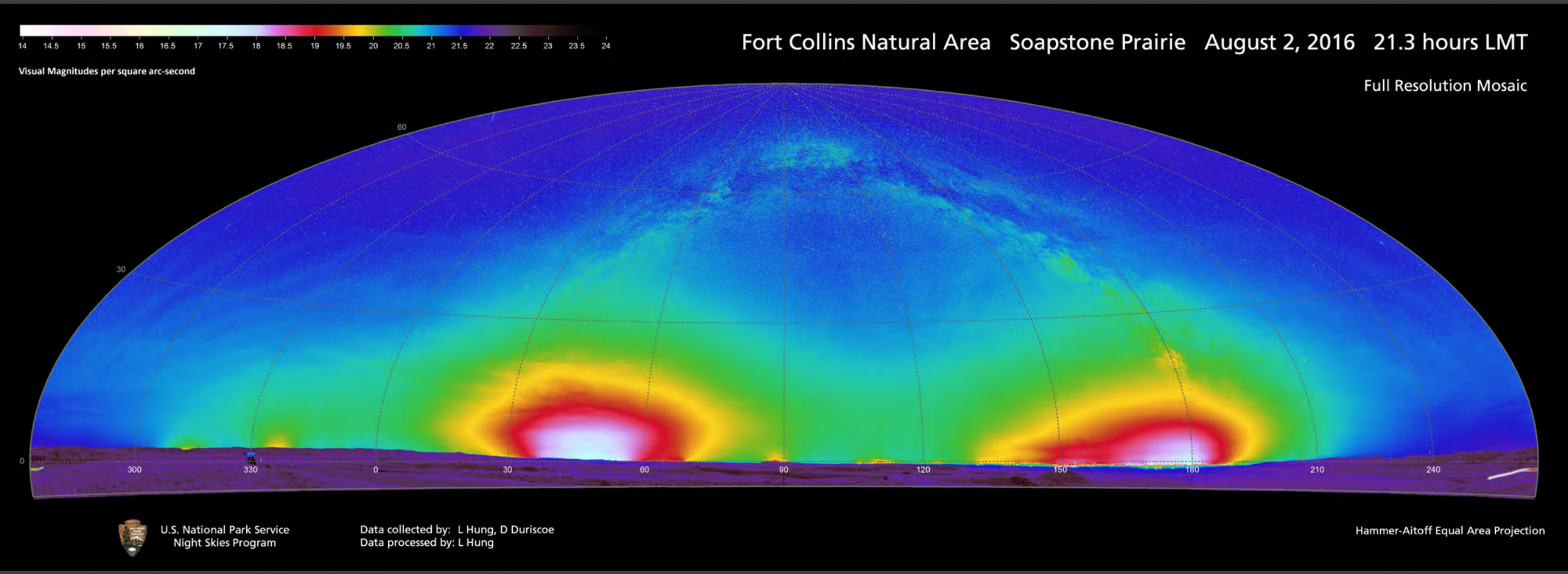


98% Stars Visible

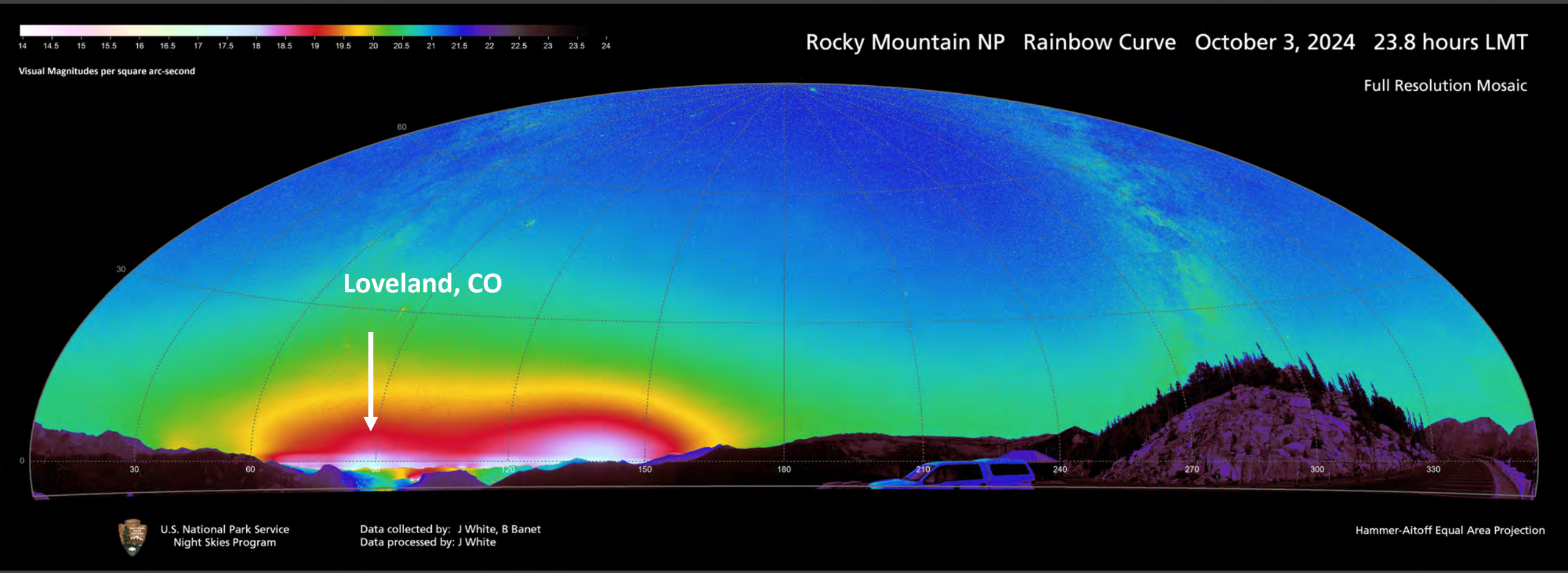
51% Stars Visible

7% Stars Visible

Location Condition: Soapstone Prairie

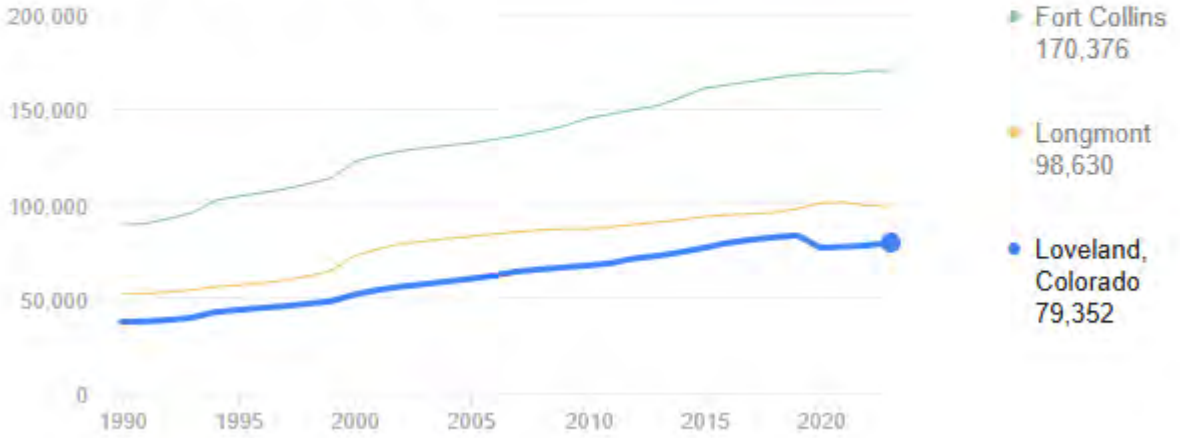


Location Condition: Rainbow Curve (ROMO)



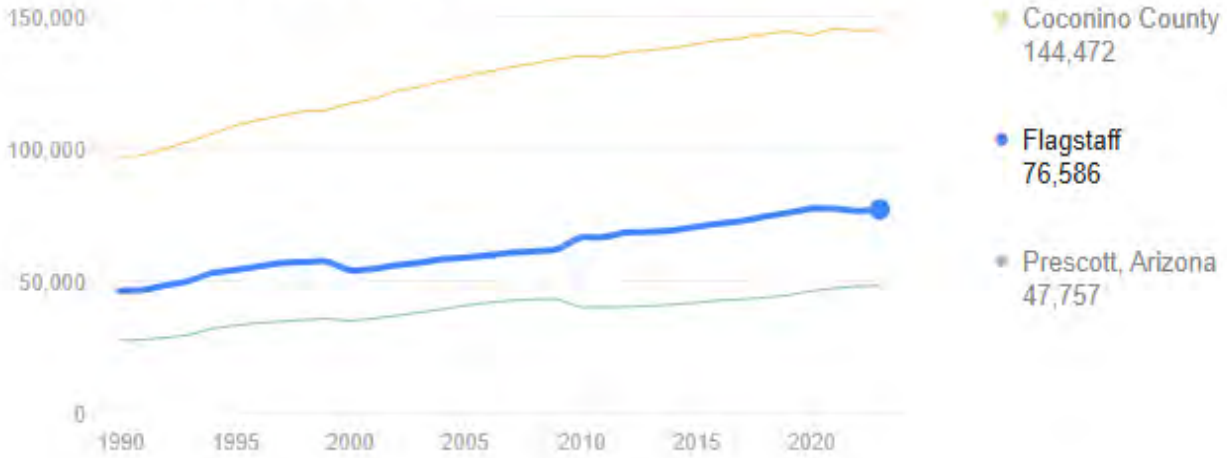
Loveland / Population

79,352 (2023)

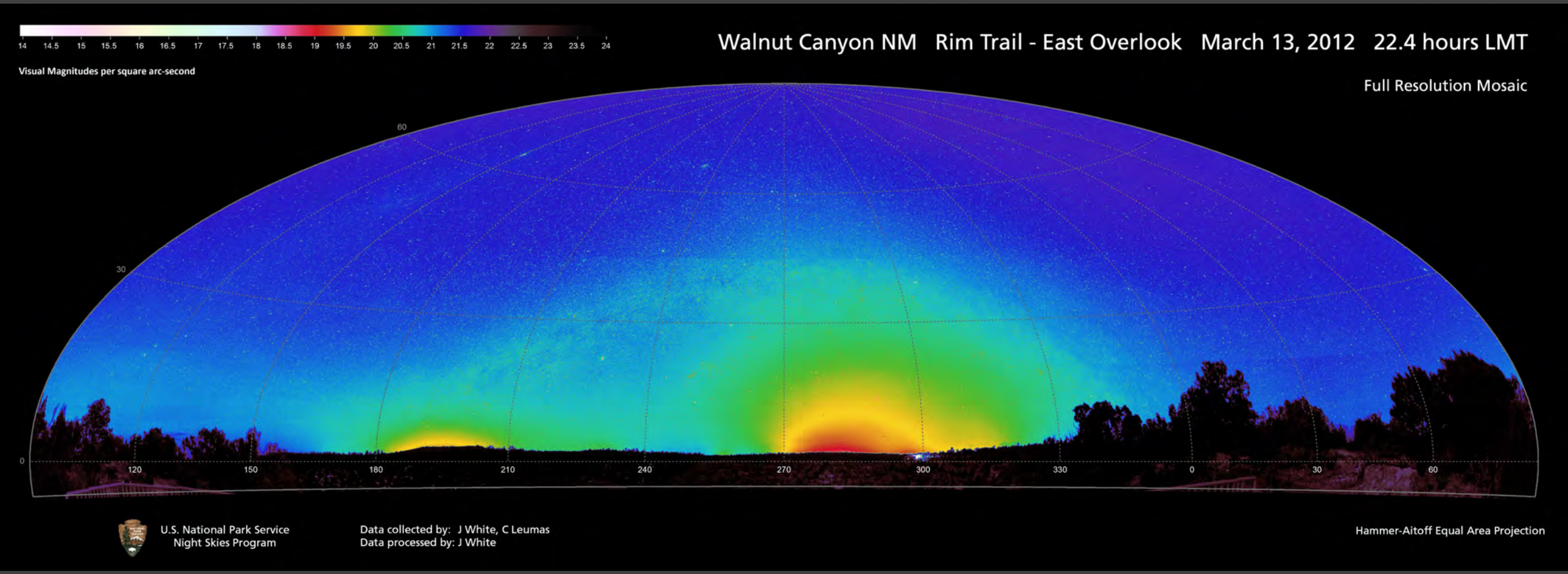


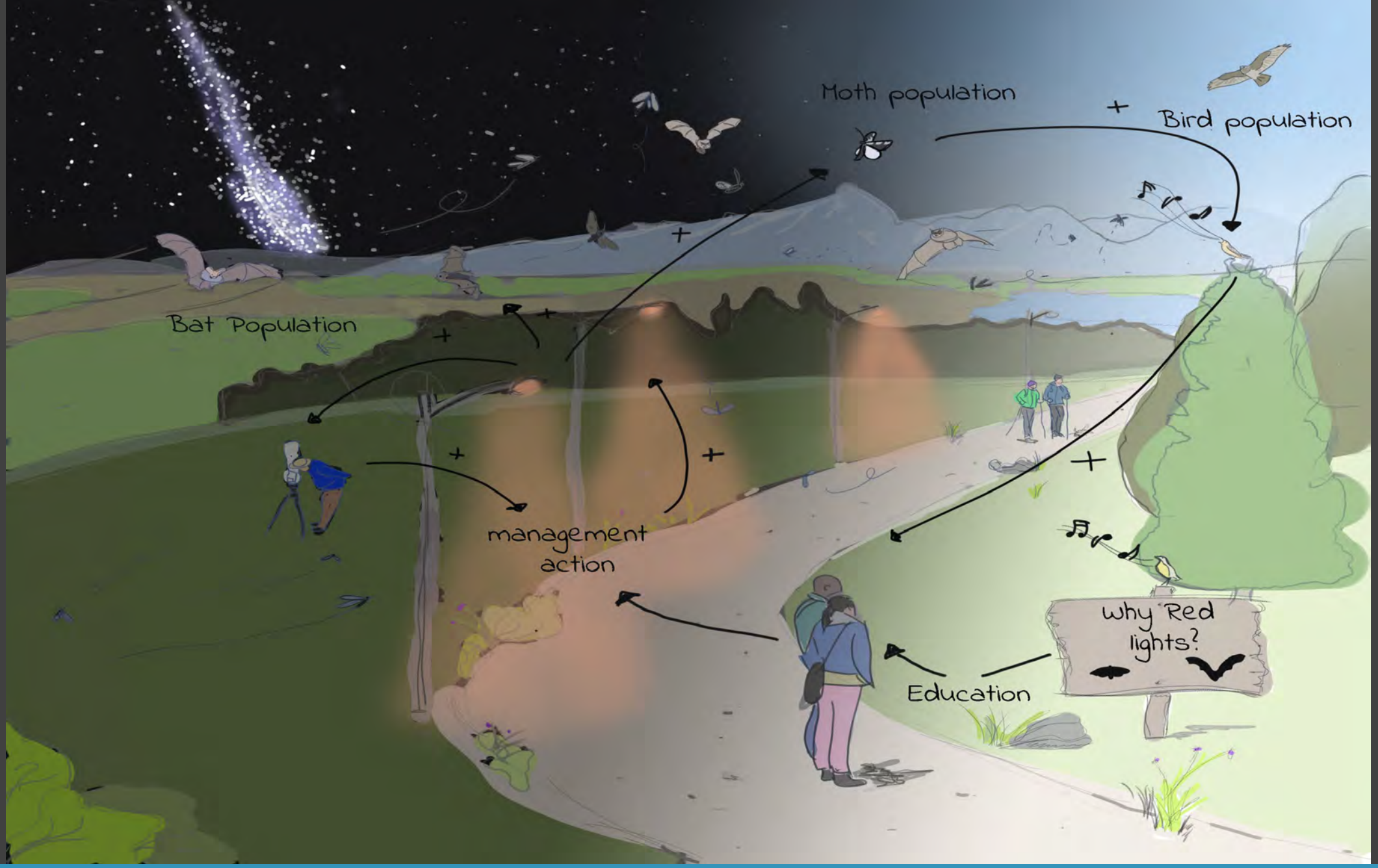
Flagstaff / Population

76,586 (2023)

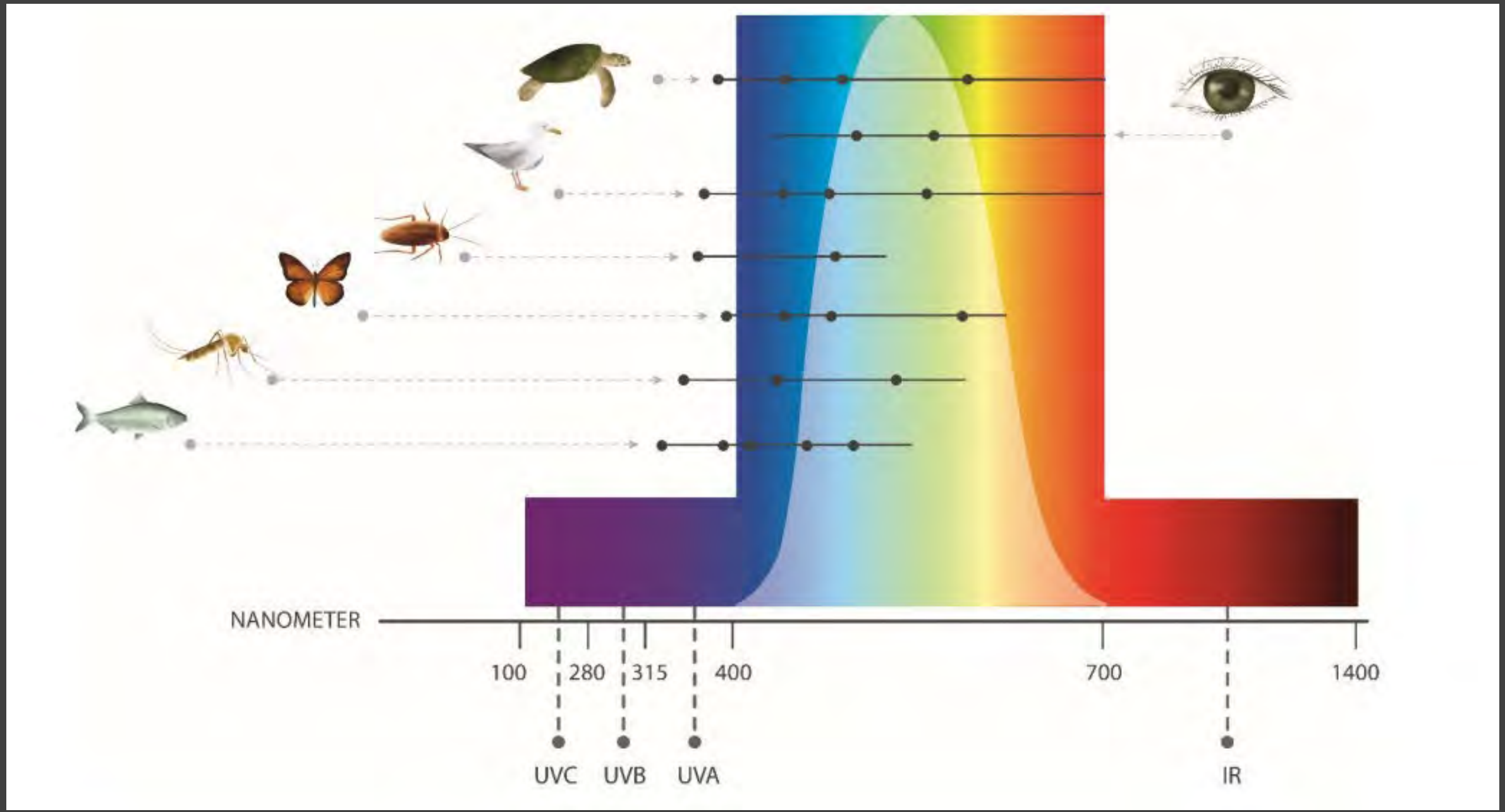


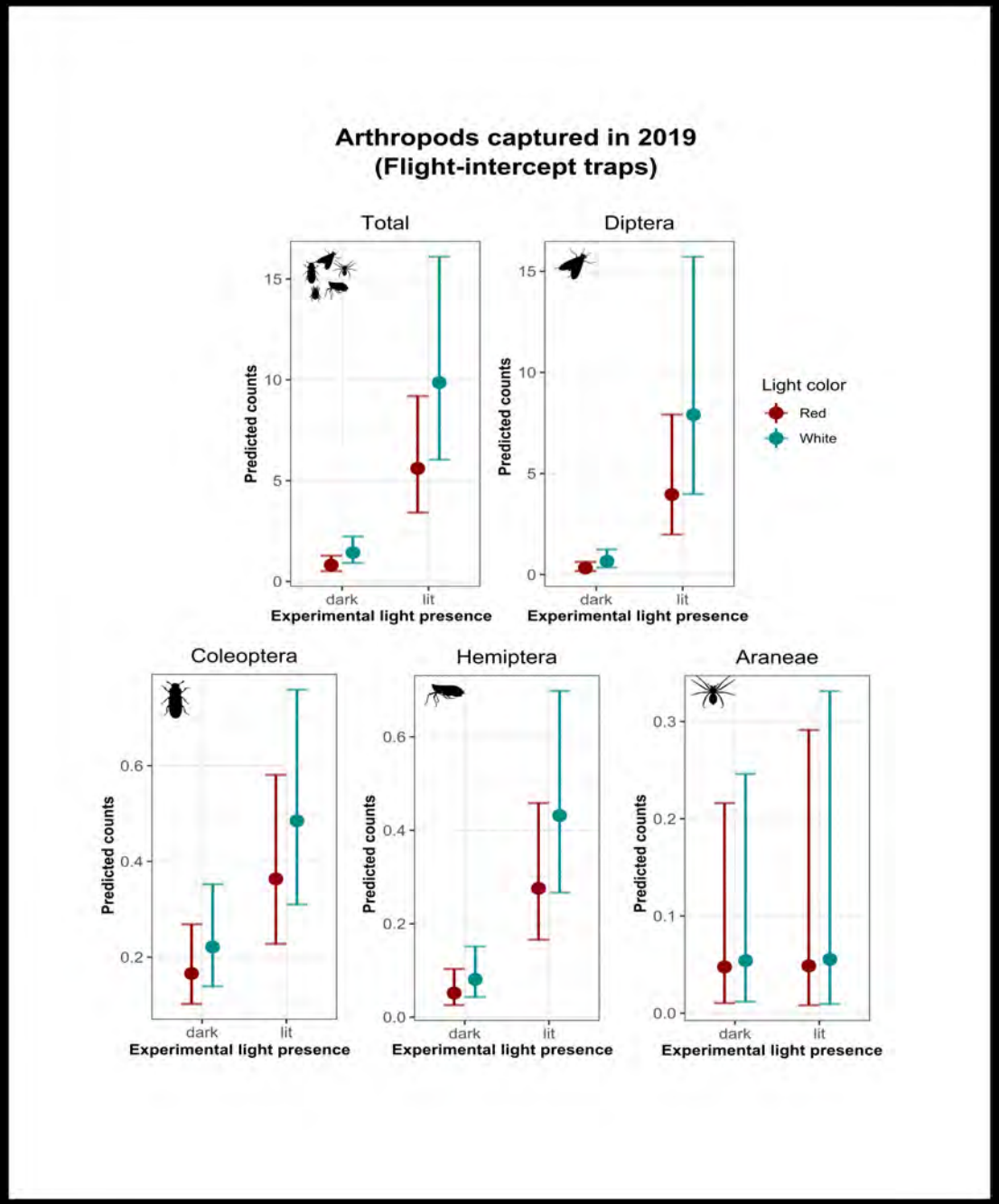
Location Condition: Flagstaff, AZ

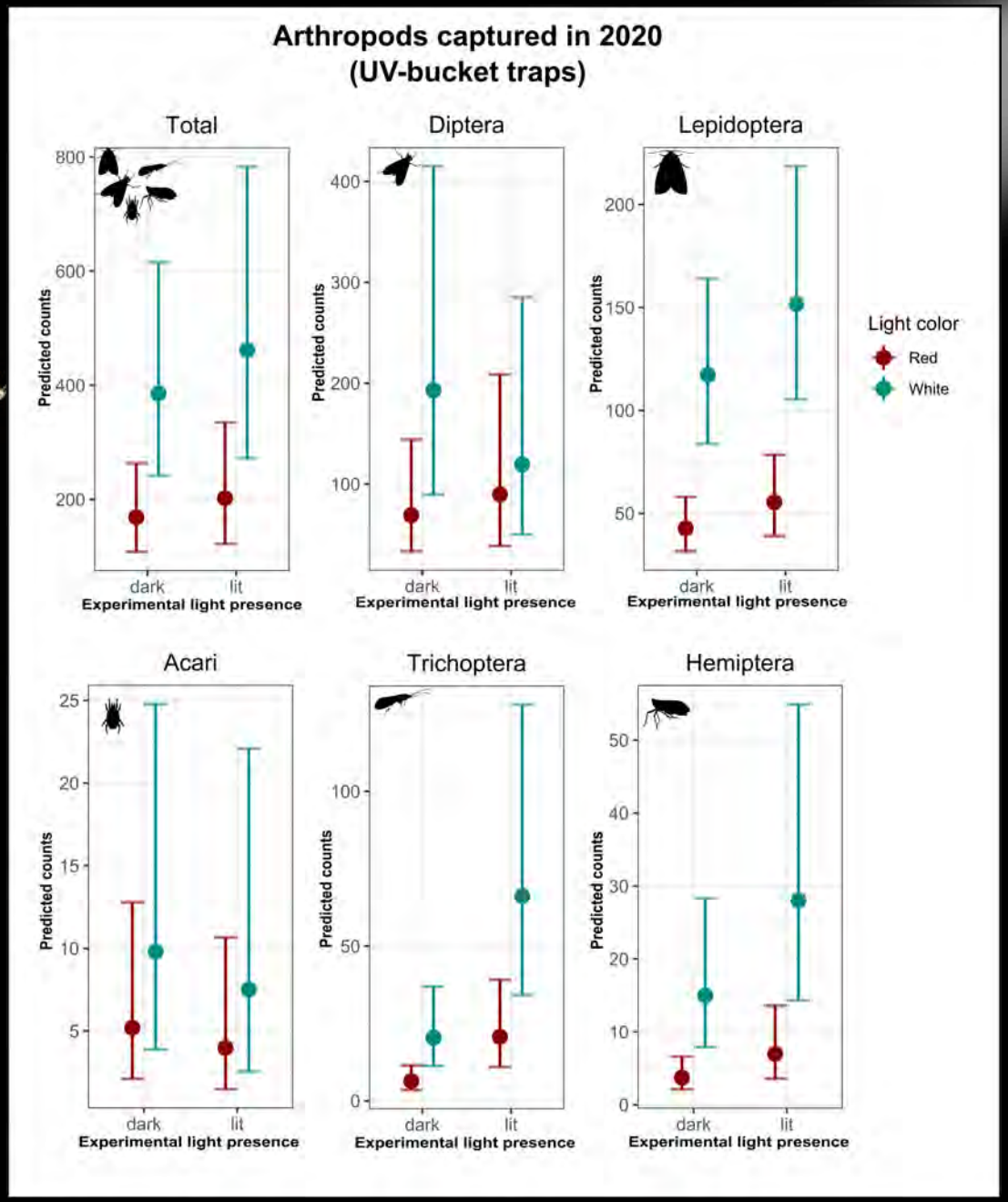



Moth population
+
Bird population
Bat Population
+
+
+
+
management
action
+
why Red
lights?
Education

Ecosystems


NANOMETER
100
280
315
400
700
1400
UVC
UVB
UVA
IR





Cole et al. *in review*

Urban Trees (Flora)

Impacts of streetlights on vegetation

Key Findings From Research

Wildlife

- Responses to lighting is species specific
  - Sea turtles are sensitive to short wavelengths (white light)
  - Firefly communication is disrupted by amber lights
  - Moths and most flying insects are drawn to white lights
- Rule of thumb suggest that longer wavelength light is more protective of ecosystems
- Lighting in otherwise dark locations can create an ‘ecological sink’ or light traps for insects.
- The influence of the light is further away than expected. (small and large scales & terrestrial and aquatic)

Human Dimensions


So how do visitor respond when you light up the night like this?

Journal of Environmental Psychology 97 (2024) 102374

Contents lists available at ScienceDirect

Journal of Environmental Psychology

journal homepage: www.elsevier.com/locate/jep

Feelings of safety for visitors recreating outdoors at night in different artificial lighting conditions

Elizabeth A. Himschoot [a,*], Morgan C. Crump [a], Stephanie Buckley [a,b], Chang Cai [c], Steve Lawson [d], Jeremy White [e], Adam Beeco [e], B. Derrick Taff [a], Peter Newman [a]

[a] Department of Recreation, Park, and Tourism Management, Penn State University, University Park, PA, 16802, USA
[b] South Dakota Game, Fish and Parks, Rapid City, SD, 57702, USA
[c] Otak, Inc., Louisville, CO, 80027, USA
[d] DJ&A, PC, Etna, NH, 03750, USA
[e] Natural Sounds and Night Skies Division, National Park Service, Fort Collins, CO, 80522, USA

Journal of Environmental Management 345 (2023) 118878

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Support for management actions to protect night sky quality: Insights from visitors to state and national park units in the U.S.

J. Adam Beeco [a,*,2], Emily J. Wilkins [b,c,d,2], Anna B. Miller [c,d], Chase C. Lamborn [c,d], Sharolyn J. Anderson [a], Zachary D. Miller [c,d,1], Jordan W. Smith [c,d]

[a] Natural Sounds and Night Skies Division, National Park Service, Fort Collins, CO, 80525, USA
[b] U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO, 80526, USA
[c] Institute of Outdoor Recreation and Tourism, Utah State University, Logan, UT, 84322, USA
[d] Department of Environment and Society, Utah State University, Logan, UT, 84322, USA

sustainability

MDPI

Article

Perceptions of Personal Lighting Devices and Associated Behaviors: Shifting Personal Norms and Behavior for Broader Conservation Actions

Morgan Crump [1], Brendan Derrick Taff [1,2,*], Elizabeth A. Himschoot [1], Jennifer Newton [3], Adam Beeco [4] and Peter Newman [1]

scientific reports

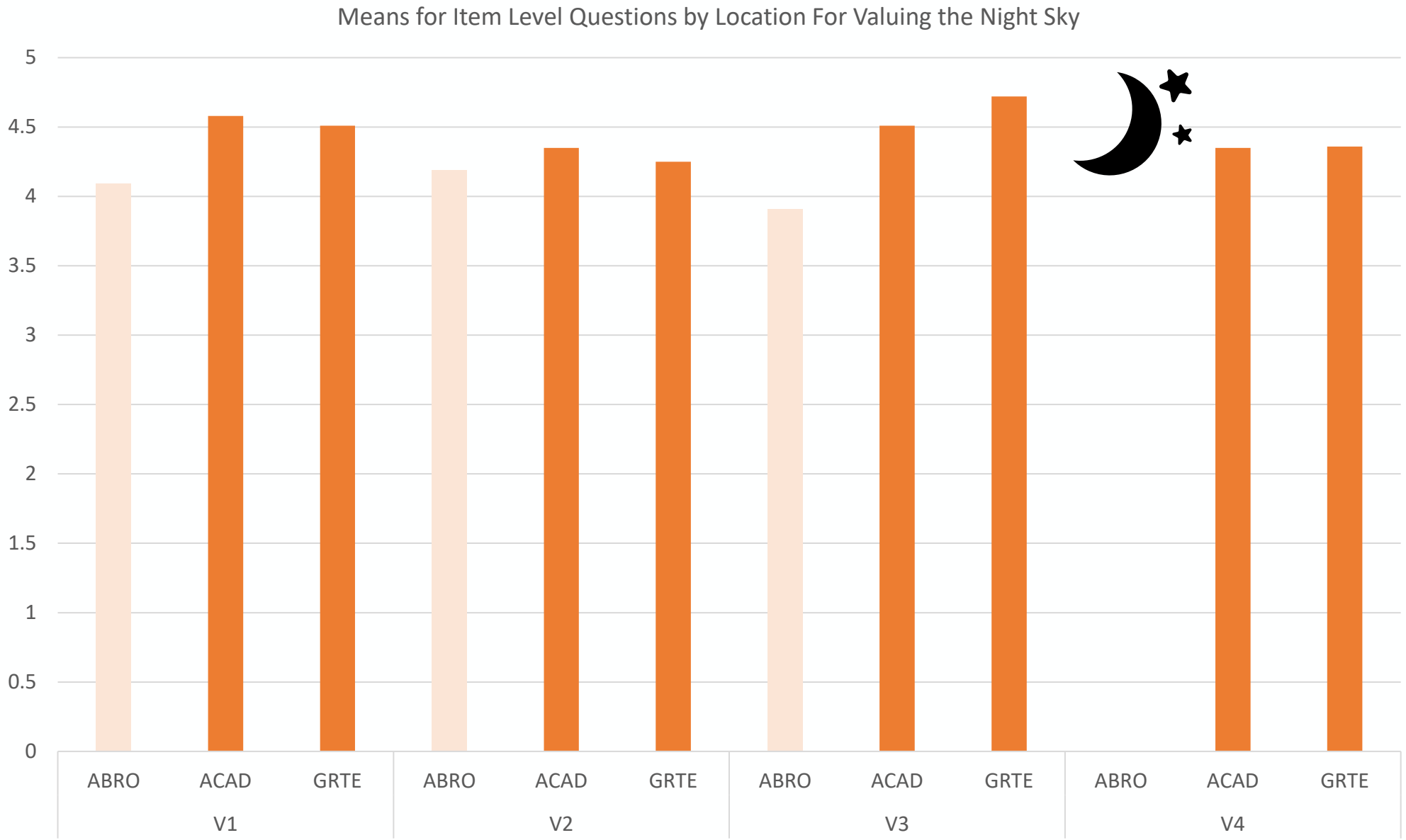
Understanding Visitor Perception of Artificial Light at Night in Natural Areas: A Study of Visitor Experience in Determining a Light Level Threshold

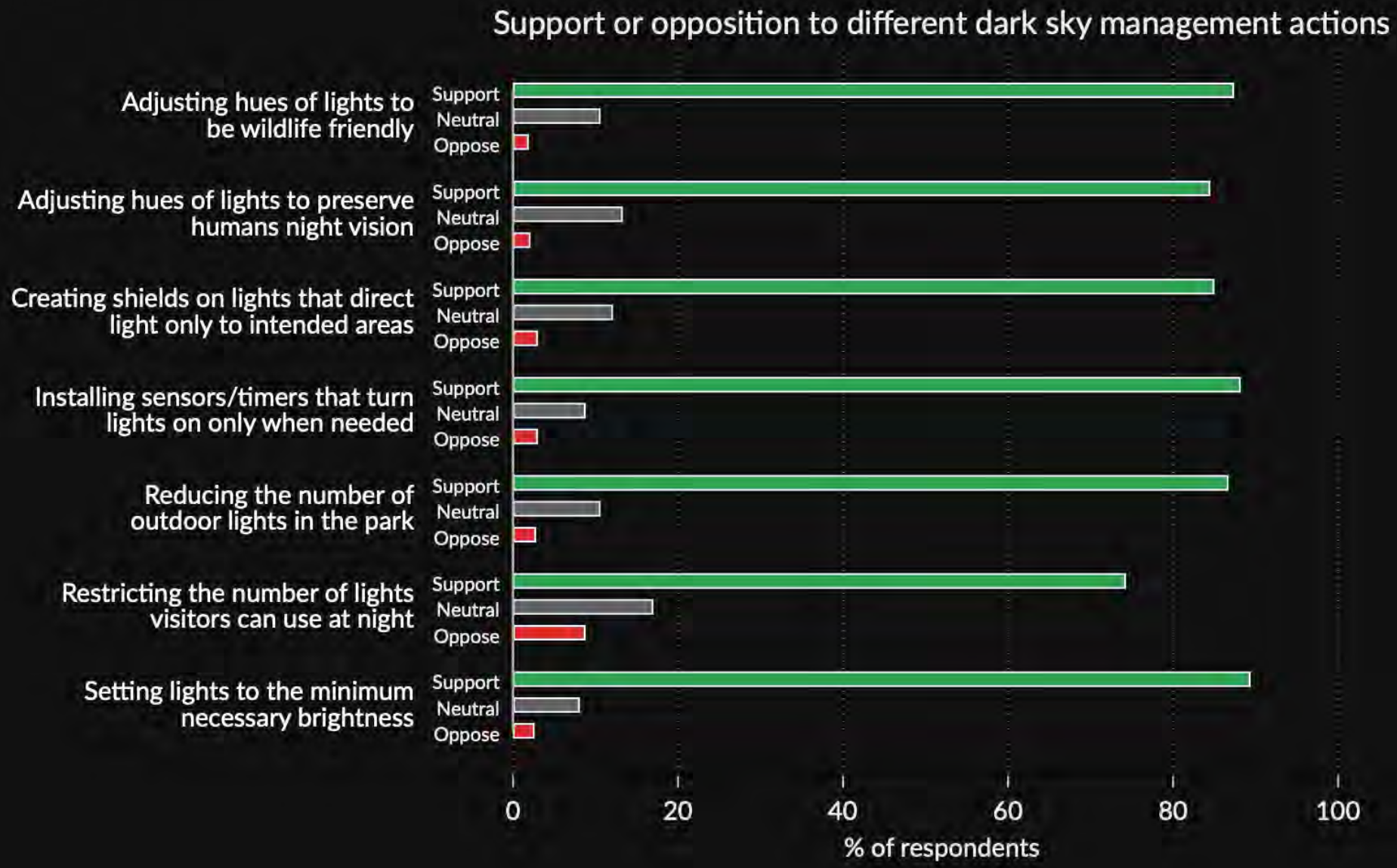
Author: Crump, Morgan

Graduate Program: Recreation, Park and Tourism Management

National Park visitors perceive benefits for themselves and wildlife under blended red-white outdoor lighting

Kurt Fristrup[1,10]✉, Zachary D. Miller[2], Jennifer Newton[3], Stephanie Buckley[4], Hunter Cole[5], Carlos Linares[5], Maurice Donners[6], B. Derrick Taff[7], J. Adam Beeco[1], Jesse Barber[8,10] & Peter Newman[9,10]


Means for Item Level Questions by Location For Valuing the Night Sky
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
ABRO
ACAD
GRTE
V1
ABRO
ACAD
GRTE
V2
ABRO
ACAD
GRTE
V3
ABRO
ACAD
GRTE
V4



Most park visitors support management actions to make parks darker

Major Findings

- Park visitors value the night sky
  - So do participants in our arboretum sample, but less so
- Overwhelmingly nighttime park visitors support management actions to make parks more natural at night
- Many park visitors are dependent on dark night skies for their activities
- Park visitors are willing to make tradeoffs in lighting for humans needs for more natural/wildlife friendly conditions at night
  - So do participants in our arboretum sample, but less so
- Most park visitors support amber and red lighting in our in-park experiments
  - Including both pathway lighting and streetlighting
- In the streetlighting study, red lighting was rated more highly on perceived benefit to ecology and visitor experience (including safety, navigation, and eye transition)
- Most park visitors support very low lux lighting in our in-park experiments for pathway lighting
- Consistently across all projects – gender and age are not good predictors of lighting preferences

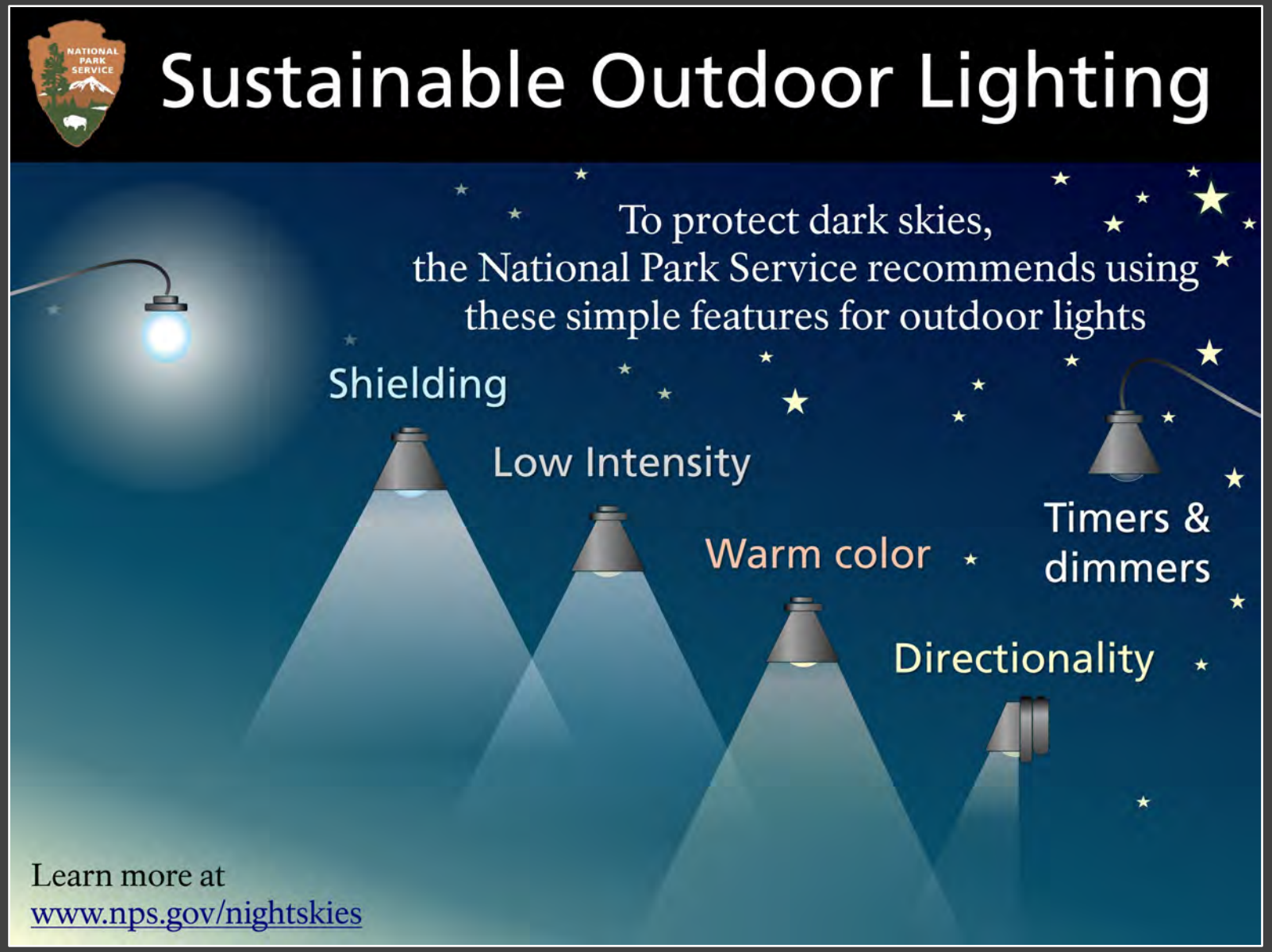
Lighting Principles

NPS Sustainable Outdoor Lighting Principles

Similar to outdoor lighting principles developed by other organizations:

DarkSky International + Illuminating Engineering Society

Design Lights Consortium



NPS Sustainable Outdoor Lighting Principles

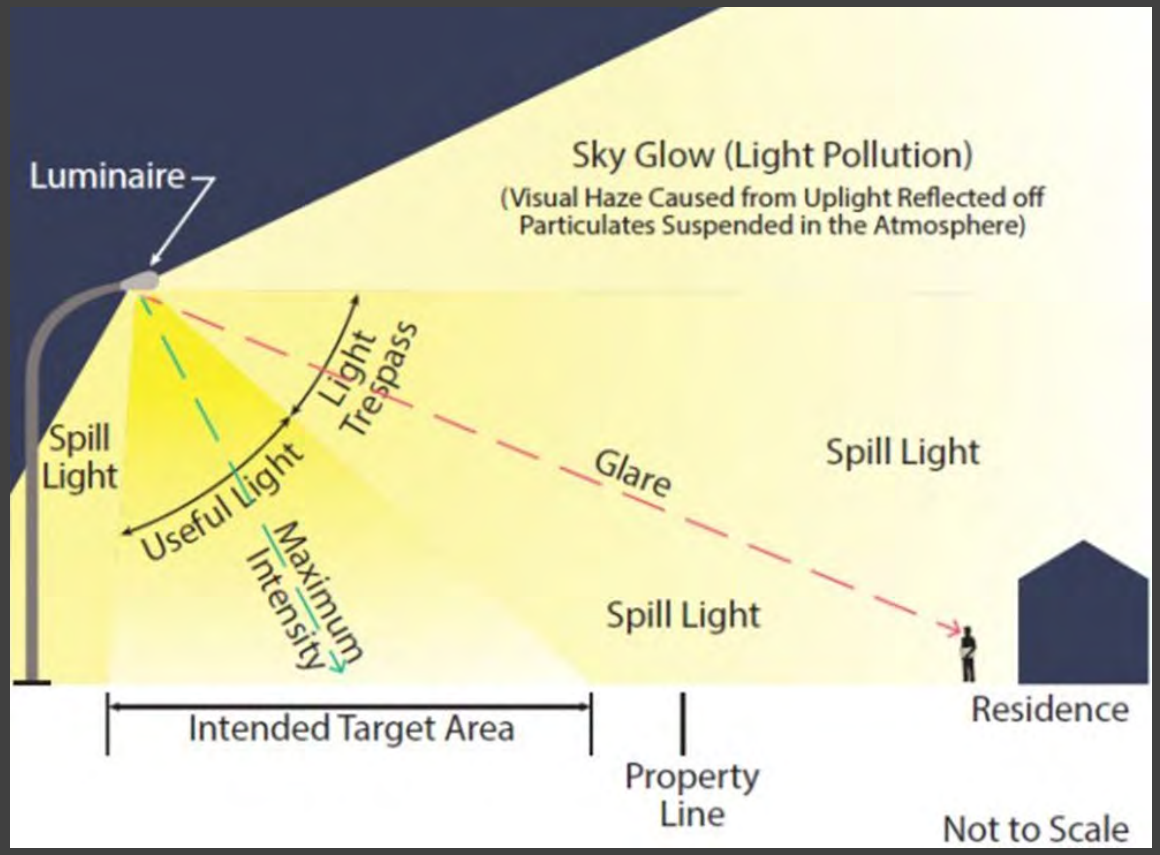
Similar to outdoor lighting principles developed by other organizations:

DarkSky International + Illuminating Engineering Society

Design Lights Consortium

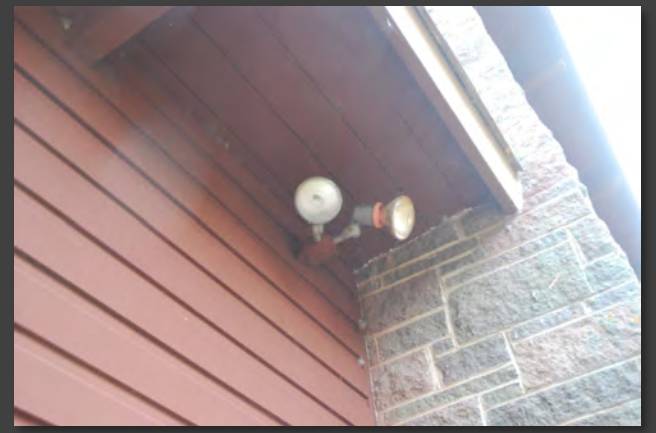
Light Only Where it's Needed

- Once lighting has been deemed necessary. ensure installed lighting is properly illuminating the task area, and no further.
- Light Pollution, light trespass, and glare often stem from the misapplication of light
- Understanding the task area helps identify light type, distribution, and intensity



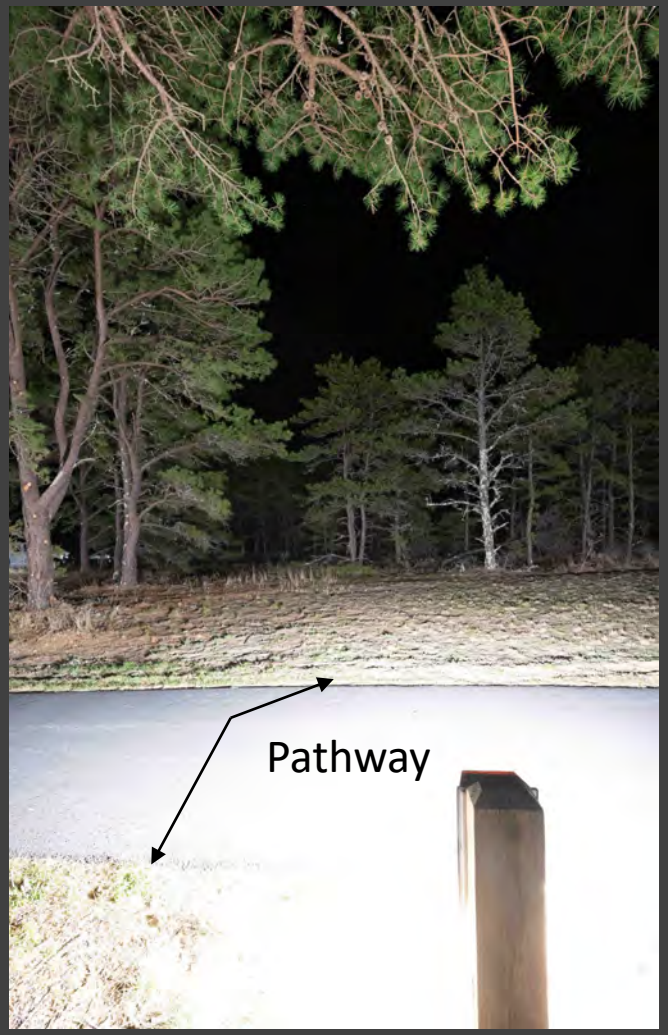
Shielding

Unshielded



Shielded

Light Only Where You Need To



Light Only When You Need To

1:00 AM

Leave No Trace: Dark Sky & Artificial Lighting Guidelines

When recreating at night, be prepared to see the stars! Consider the following guidelines to reduce your impacts and help preserve the natural dark sky:

IS LIGHT NEEDED?

First, ask yourself if additional light is needed to facilitate your activity. Often our eyes can adjust to the dark sky and still feel safe to enjoy recreational activities without artificial light. It takes between 20 to 30 minutes for the human eye to fully adjust to darker environments.

REFLECTIVE TAPE

For safety purposes, consider reflective tape or gear with reflective materials rather than using artificial lights

LIGHT INTENSITY

If artificial light is needed to facilitate your activity, use only the light intensity that is necessary (e.g., headlamps rather than vehicle headlights or the lowest setting needed on a headlamp). Use LEDs with warm colors such as yellow, amber or red at lower intensity levels, rather than white or blue lights, which can impact the health of wildlife and humans. These warmer lights also allow for human eyes to adjust more quickly to darkness after being turned off.

DIRECTION OF LIGHT

Keep all artificial lighting pointed down and only in the direction where light is necessary.

LOW-LUMEN HEADLAMPS

Depending on your outdoor activity, consider purchasing/using headlamps (and other types of outdoor-recreational lighting) with a low-lumen/intensity output that offers either a fully red/amber light or at least a red/amber light cover.

SAVE ENERGY

Save your batteries or energy and turn off all lights when not in use.

AVOID HEADLIGHTS

In campgrounds, only use vehicle headlights when driving or when absolutely necessary; avoid use while preparing camp. Plan ahead and prepare camp/tent set up before dark to avoid the need for lights.

USE DARK SKY FRIENDLY LIGHTING

In campgrounds, backyards, on campers, and other recreational vehicles refrain from decorative lighting, and when using purposeful lighting, use lights that are "dark sky friendly." The International Dark-Sky Association recommends using long-wavelength lighting with a color temperature of less than 3000 Kelvins, fully shielded and directed downward.

Recommendations based on empirical science and co-created between Leave No Trace and the U.S. National Park Service Natural Sounds and Night Skies Division.

LEAVE NO TRACE

Enjoy Your World, Leave No Trace!

www.LNT.org

Other Resources

- DarkSky International (formerly International Dark Sky Association)
- Illuminating Engineering Society
- Design Lights Consortium
- Colorado Plateau & Basin and Range Dark Sky Cooperatives:
  - Dark Skies Toolkit
  - Gateway and Natural Amenity Region (GNAR) Initiative
  - Quarterly CONNECTIONS Webinars
  - Light pollution map
- National Park Service
  - Night Sky Data Map and Snapshots
    - Night Sky Data Collection Sites (nps.gov)
    - Guide to Snapshot Metrics
  - Night Sky Monitoring Reports
    - DataStore - Collection Profile - Collection ID 9562