

# Workshop on Dark Skies

Dark Sky International / NM Dark Sky chapter

December 1, 2023

New Mexico Tech, Socorro NM

# Welcome!

- Motivation
  - Dark Sky International, Carroll-Petrie Foundation, and the NM State chapter
  - Preserve and enhance dark skies
  - Building a broad coalition
- Meeting goals
  - Learn about different perspectives and activities related to dark skies
  - Learn about resources and tools
  - Discuss: how to build a **broader** coalition
  - Discuss: how to work as a coalition
  - Discuss: building a roadmap :
    - Specific actions : short-term and long-term
    - General actions
- Thanks!

# Agenda

- 9:30-10:00 : Introductions
  - Introduction / motivation /agenda : Jon Holtzman
  - Importance of Dark Skies and DarkSky International : Ruskin Hartley
- 10:00-11:30 : Building a broader coalition : perspective and ongoing efforts
  - 14 short presentations from various groups
  - Short break in the middle!
- 11:30-12:00 : Short breakout sessions
  - Ideas for broadening coalition, working together, dreams, and challenges
- 12:00-1:00 : LUNCH
- 1:00-2:00 : Dark sky information and resources
  - NM Night Sky Protection Act : Peter Lipscomb
  - Local ordinances in NM : Galen Gisler
  - Best practices and DarkSky International resources : Brian Liebel
  - IES Standards and technical tools : Billy Tubb
- 2:00-3:30 : Breakout sessions on specific topics: developing actions
  - 40 minute group discussion
  - 40 minute group feedback
- 3:30-4:00 Closing comments / future plans

# Morning presentations : building a broad coalition for dark skies

- Cody Johnson : NM True
- Grady Owens : NM Skies
- McKinney Briske : BLM
- Peter Lipscomb : NM State Parks
- John Winscott / Brian McLoughlin (State lands office)
- Zandra Fleming : NMOGA
- Brian Jensen : Santa Fe Conservation Trust
- Trish Cutler : WSMR/DoD/Audubon
- Anna Walker : NM Biopark
- Catherine DeMaria / Marisela LaGrave : Dark Sky Land
- John Briggs : Astronomical Lyceum
- Antoine Ribaut : Magdalena Astronomical Society
- Eileen Ryan : New Mexico Tech
- Robert Johnson : Starfire Optical Range

# Dark skies

*In the land of enchantment*



DarkSky

Dark sky workshop  
Socorro, New Mexico  
December 1, 2023

Ruskin Hartley







# innovation





cheaper

# perpetual twilight





Bettymaya Foott

# noctalgia

*noun*

sky grief for the accelerating loss of the home environment of our shared skies

to be best in  
point of view.

**Paradigm** ['pærɪdɪɡm] n.  
typical example.  
accepted perspective  
discipline at a given time.

finding value in darkness

A night photograph of a park. In the foreground, a person is seen from behind, pushing a white lawn mower through tall grass. The word "people" is overlaid across the middle of the image in large, bold, black letters. The background features a building with several lit windows and a bright street lamp or light fixture that creates a strong lens flare effect, illuminating the surrounding trees and foliage.

people

An aerial night photograph of a dense urban area, likely Chicago, showing a vast expanse of city lights from numerous buildings and street intersections.

energy

# *Wildlife: Who's out at night?*



**90%** amphibians

**69%** mammals

**60%** invertebrates

**30%** birds

from awareness to action

light at night *is* pollution

it can be *solved* at the speed of light



and it does not mean  
turning off all the lights!

DarkSky has a plan



**DarkSky**  
INTERNATIONAL

Recruits, mobilizes, and supports activists.  
Collaborates with organizations and funders.  
Certificates DarkSky policies, practices, and products.  
Monitors progress, shares collective results.



## Advocates

Advance policy solutions that support climate goals. Build on successes, scaling local > regional > national.



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### Advocates

Advance policy solutions that support climate goals. Build on successes, scaling local > regional > national.



### Policy makers

Enact and enforce effective outdoor lighting policies



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### Advocates

Advance policy solutions that support climate goals. Build on successes, scaling local > regional > national.



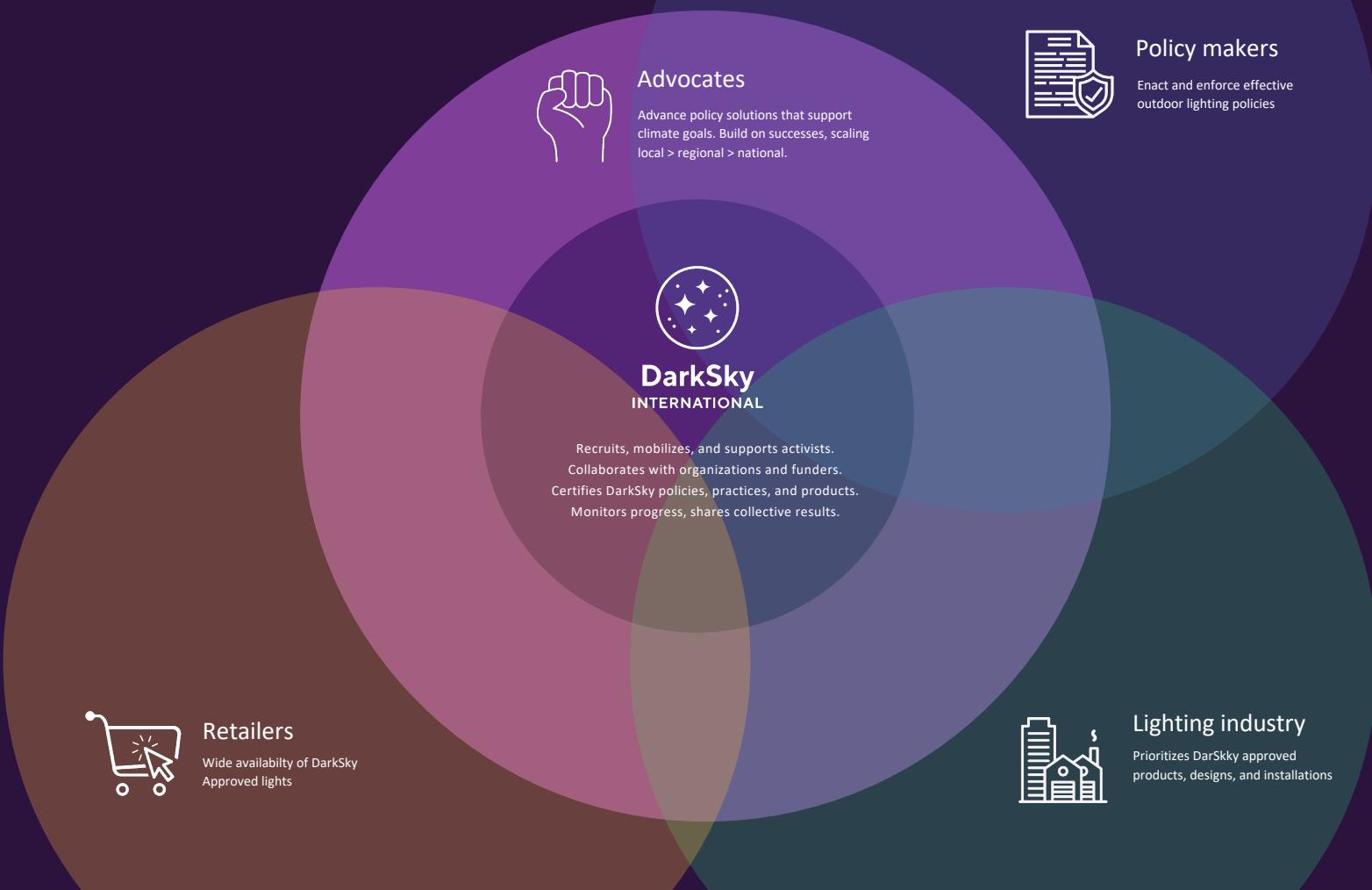
### Lighting industry

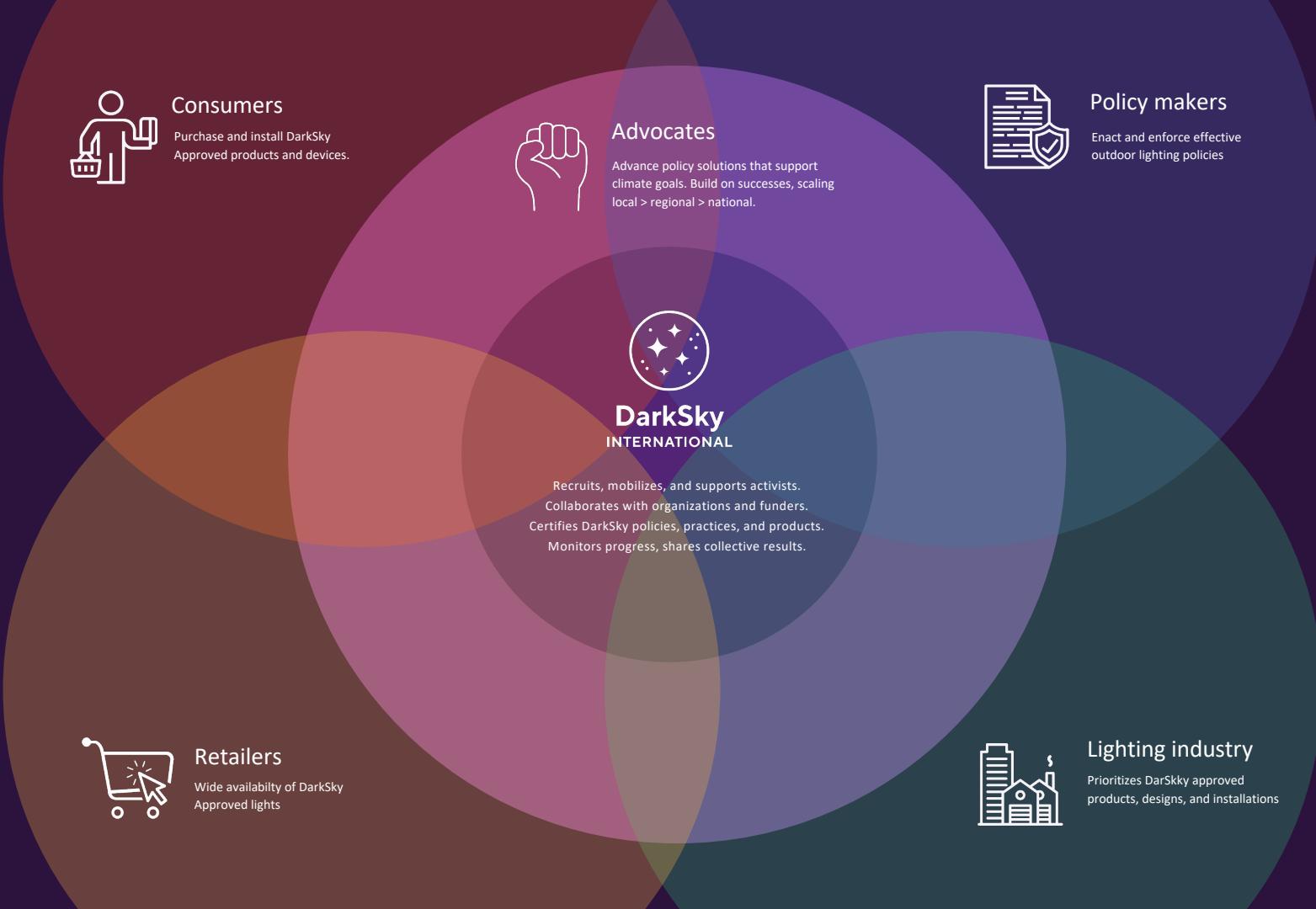
Prioritizes DarSky approved products, designs, and installations



### Policy makers

Enact and enforce effective outdoor lighting policies





# DarkSky Chapters



76

Chapters

45

Countries

6

Continents



**DarkSky**  
URUGUAY



**DarkSky**  
NEW MEXICO  
CHAPTER



**DarkSky**  
LA COUNTY



**DarkSky**  
NOVA



**DarkSky**  
ARGENTINA



**DarkSky**  
CHICAGO



**DarkSky**  
RIO DE JANEIRO



**DarkSky**  
KENYA

# Dark Sky Places



209

Certified

200

In process

6

Continents

Mt. Aenos | Park | Greece    Springdale | Community | USA

South Wairarapa | Reserve | New Zealand

Ynys Enli | Sanctuary | Wales    Groveland | Community | USA

Minami Rokuroshi | Night Sky Park | Japan

City of Rocks National Reserve | Park | USA

Parc National du Mt. Tremblant | Park | Canada

Xichong | Community | China    Bee Cave | Community | USA

Arkaroola | Park | Sanctuary

# DarkSky Policy



99  
proclamations

8  
Countries

4  
Continents



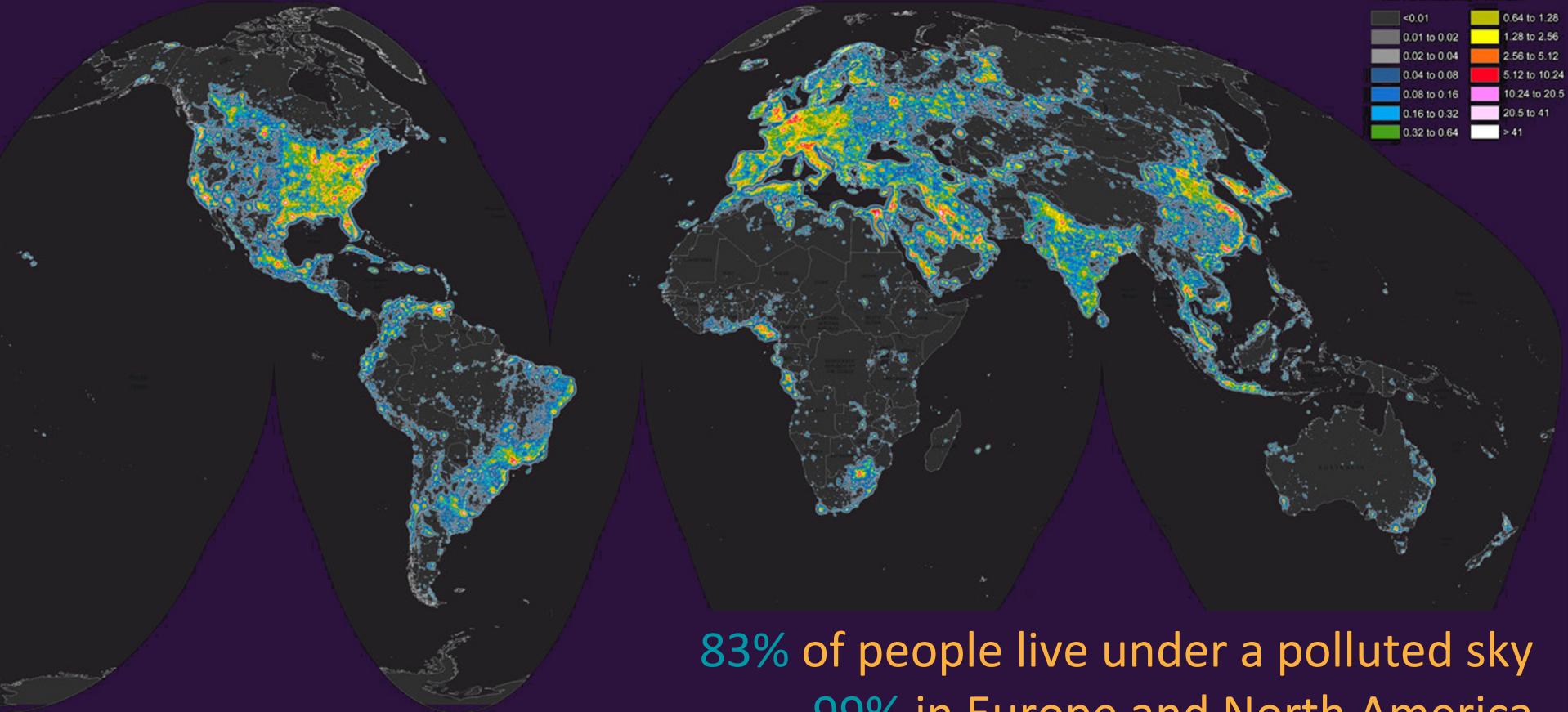
WHEREAS, the aesthetic beauty and wonder of a natural night sky is a shared heritage of all humankind; and  
WHEREAS, the experience of stargazing beneath a starry night sky inspires feelings of awe and wonder, and encourages a growing interest in science and nature, especially among young people and out-of-area visitors within the local community; and  
WHEREAS, light pollution has scientifically established economic and environmental consequences, which result in significant impacts to the ecology and human health of all communities; and  
WHEREAS, 80-percent of the world's population, including Atlantic County, live under a dome of light-pollution-excessive artificial lighting at night that disrupts natural darkness — and may never experience the visual wonder or ecological and health benefits of living under a dark sky; and  
WHEREAS, light pollution represents a waste of natural resources amounting to over \$1 billion per year of wasted energy inflatty and contributes to diminished energy security; and  
WHEREAS, South-Western Alps host some of the last dark skies left in Europe where it is still possible to observe on almost unpolluted sky; and  
WHEREAS, the International Dark-Sky Association, American USA, is the globally-recognized authority on light pollution and has created "International Dark Sky Week" to raise awareness of light pollution, and provide free education, resources, and solutions to the public to encourage the protection of and enjoyment of dark skies and responsible outdoor lighting;

Now, Therefore, I, SINDACO del COMUNE di VALGRANA (CN) do hereby declare

April 15-22, 2023 as  
INTERNATIONAL DARK SKY WEEK

What about New Mexico?

# Light pollution is a global issue....

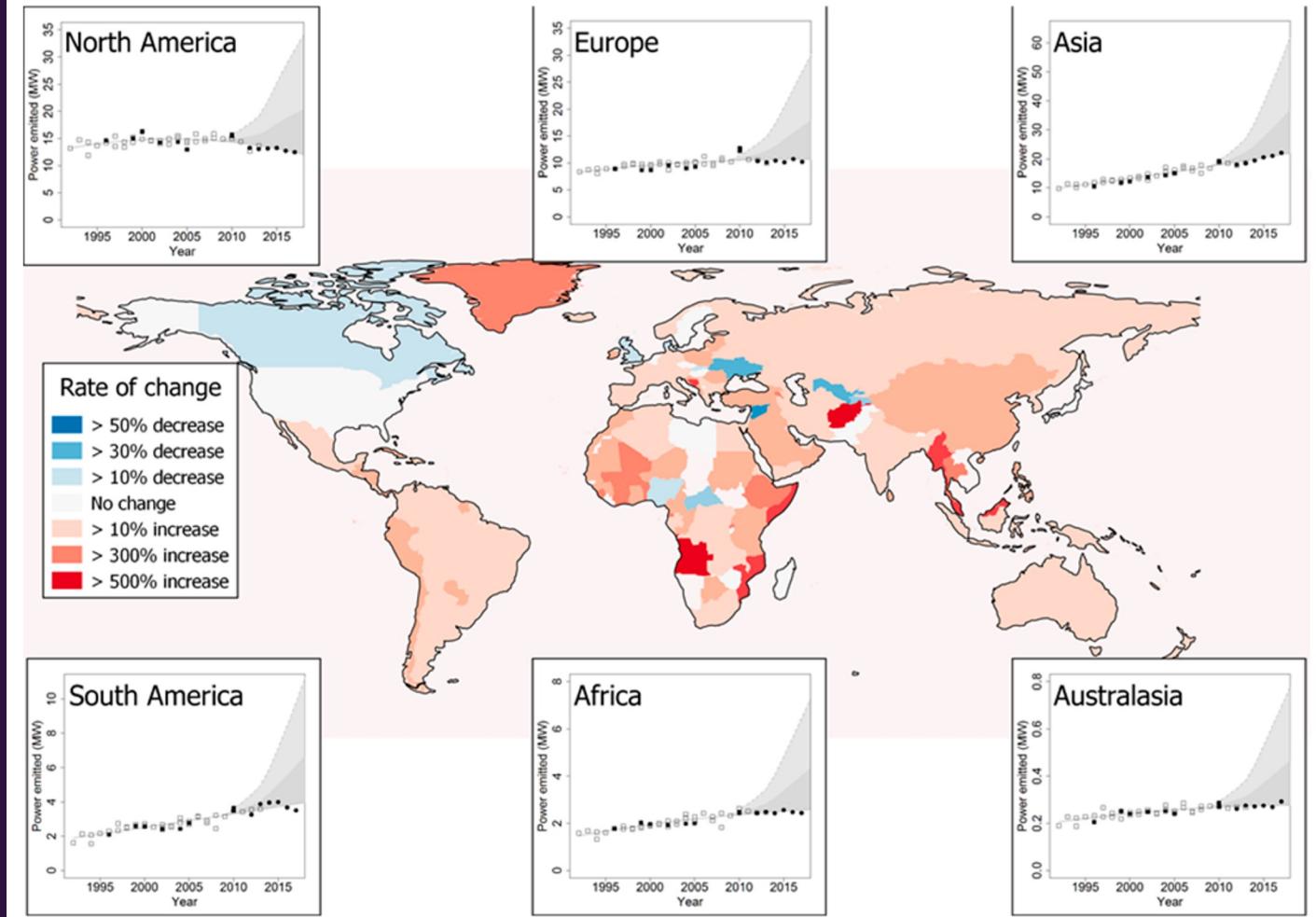


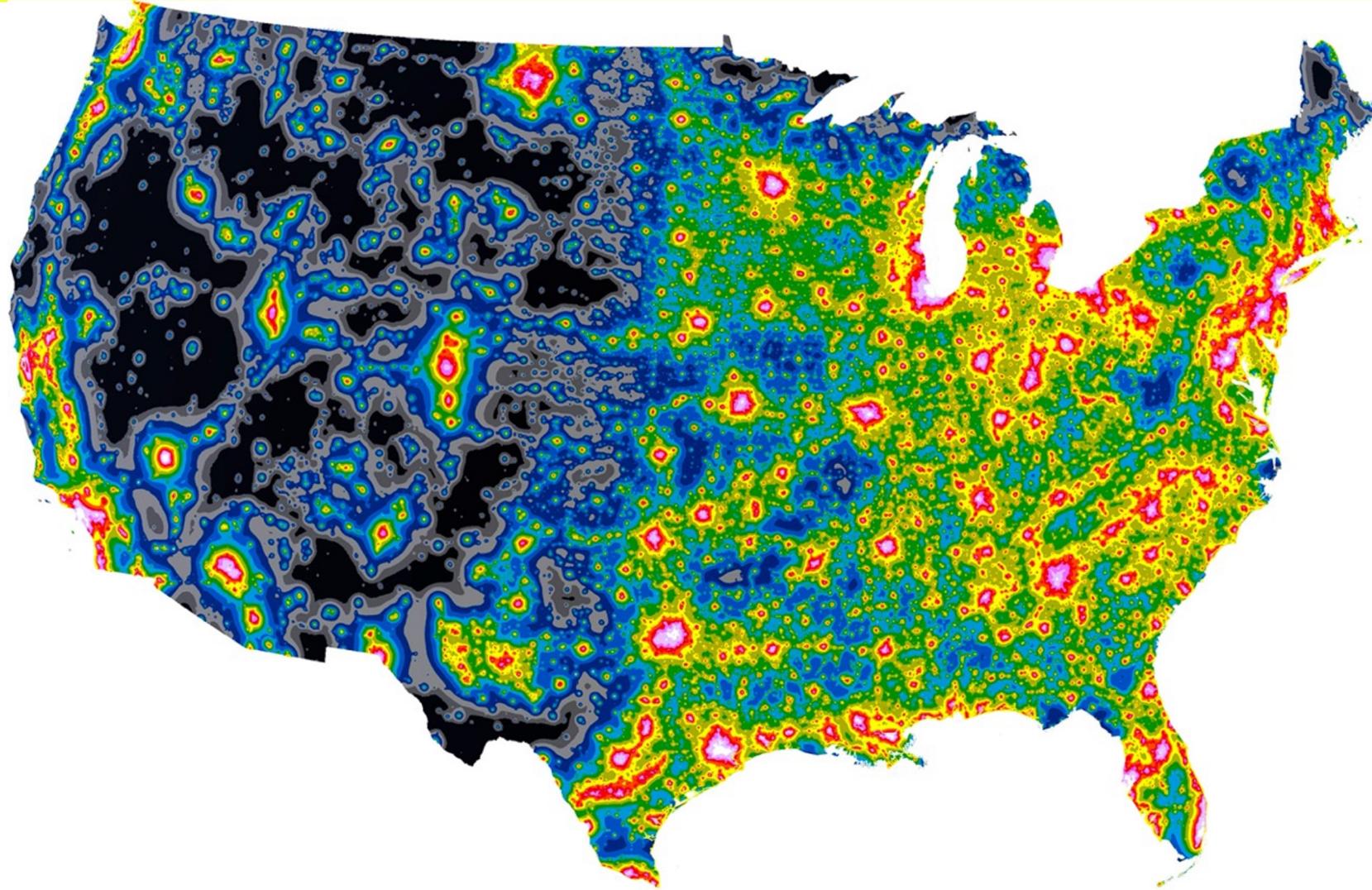
83% of people live under a polluted sky  
99% in Europe and North America

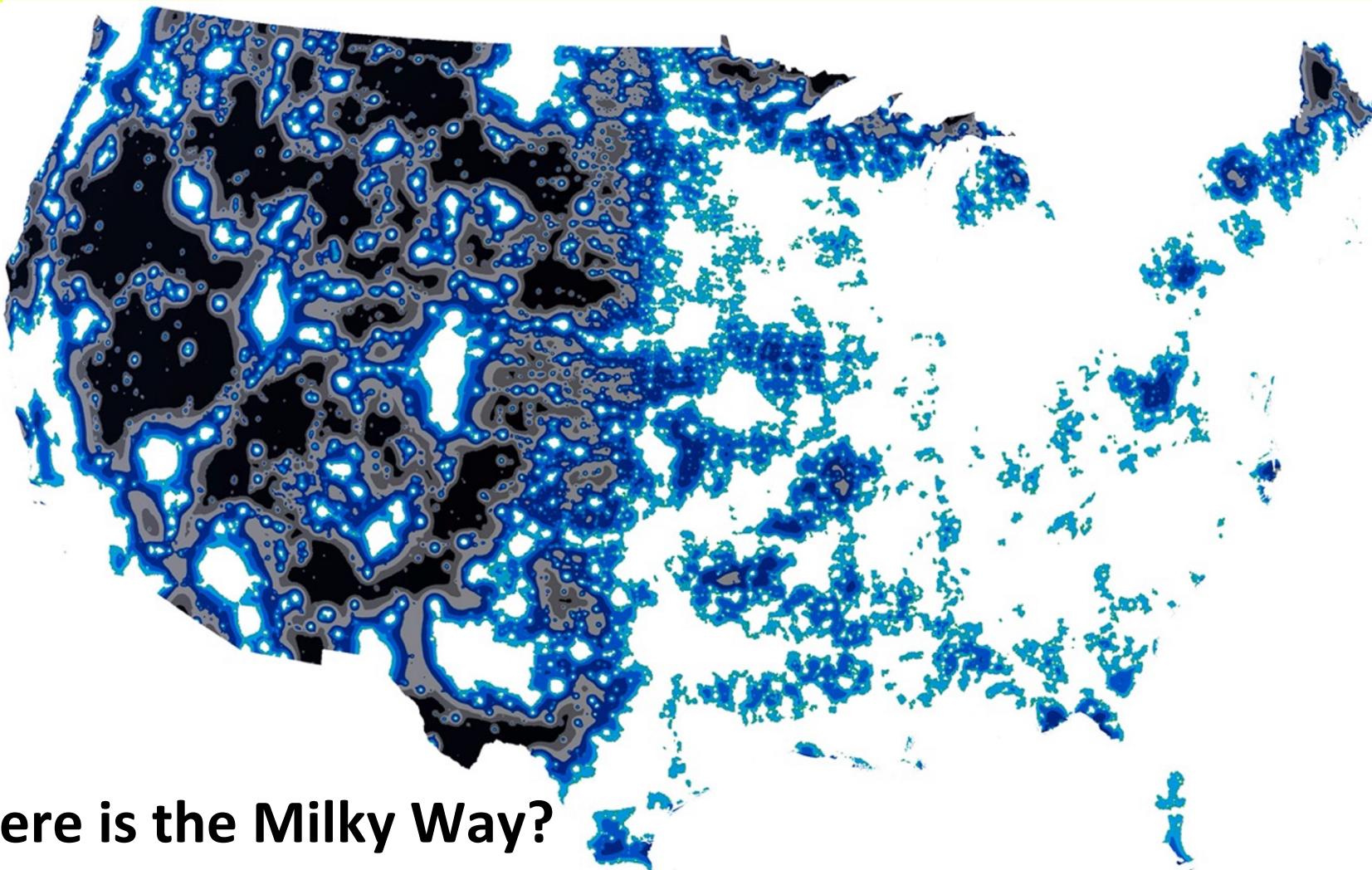
....it is  
growing,  
globally.

49% globally  
400% some regions  
over past 25 years

10% per year for past  
decade \*





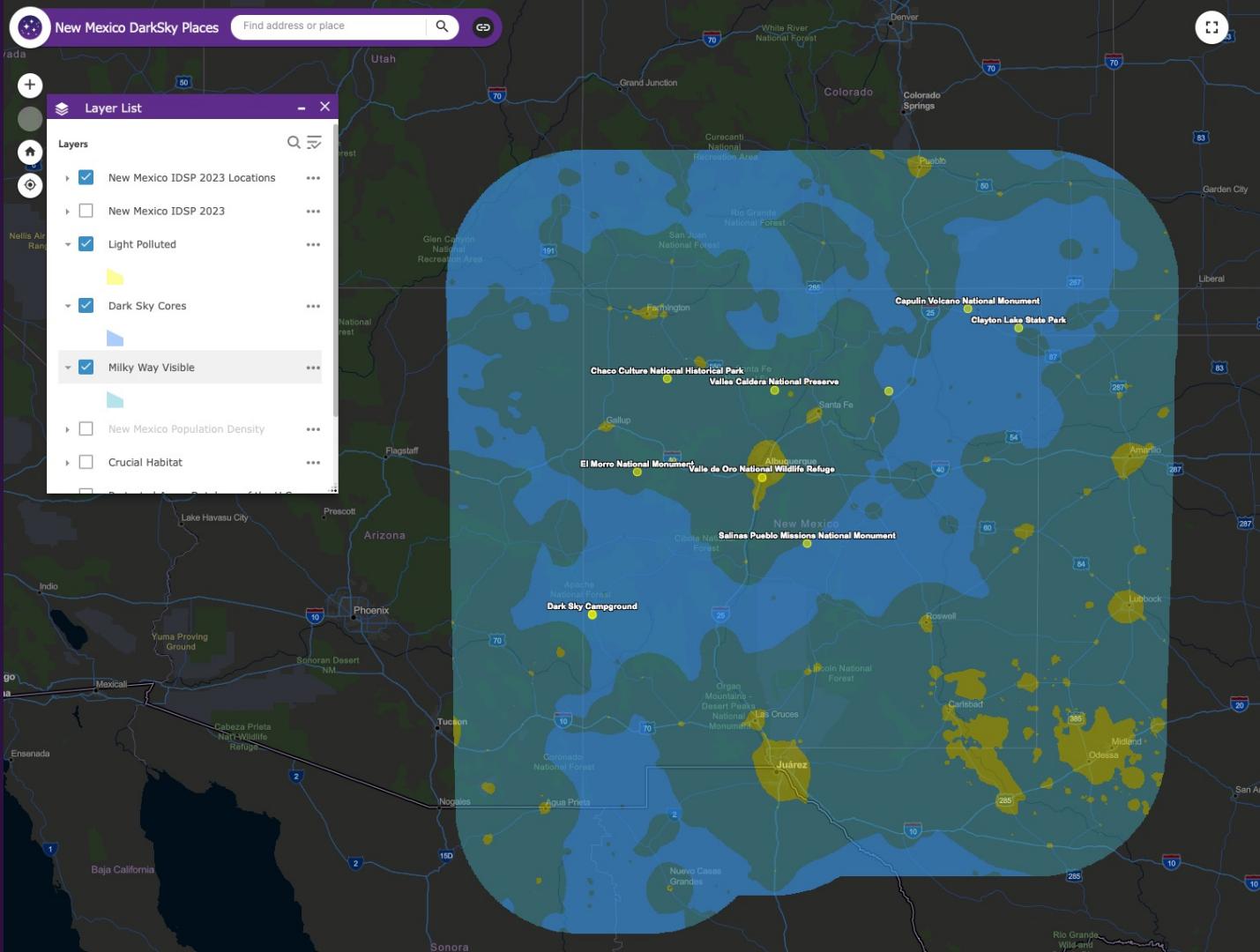


Where is the Milky Way?



**Where do pristine night skies remain?**

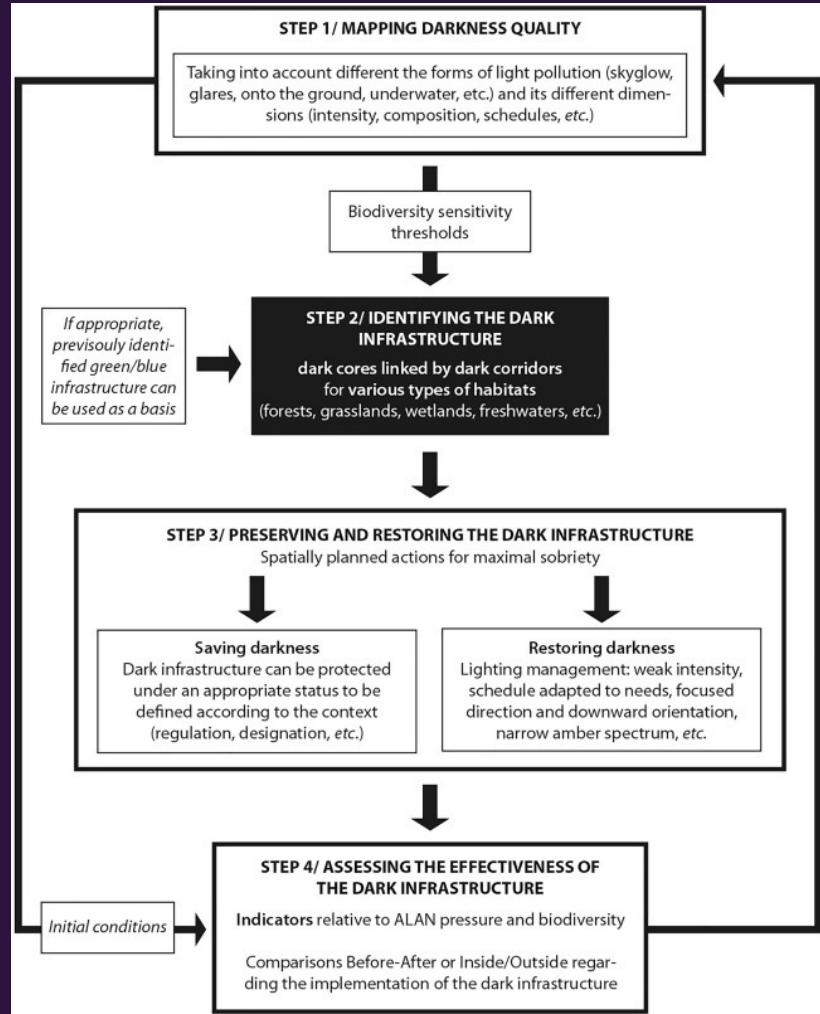
New Mexico is special!



# Dark infrastructure

*Good for...*

Environmental protection  
Economic vitality  
Social equity



In 1999  
New Mexico  
showed the way

Today, it can  
Continue to be a  
regional leader



# DarkSky



DarkSky International

Ruskin Hartley

[ruskin@DarkSky.org](mailto:ruskin@DarkSky.org)

[DarkSky.org](http://DarkSky.org)

# Morning presentations : building a broad coalition for dark skies

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- Grady Owens : NM Skies
- McKinney Briske : BLM
- Peter Lipscomb : NM State Parks
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- Eileen Ryan : New Mexico Tech
- Robert Johnson : Starfire Optical Range

**Cody Johnson : NM True**

The background is a dark, star-filled night sky over a dark landscape. A large, rugged rock formation is silhouetted against a bright horizon, appearing as a dark shape against the orange glow of the setting or rising sun.

**NEW MEXICO**  **TRUE**

The text "NEW MEXICO" is in a bold, white, sans-serif font. The word "TRUE" is also in a bold, white, sans-serif font, positioned to the right of a gold-colored Zia symbol. The Zia symbol is a circular design with four rays extending from a central circle, representing the sun, life, death, and rebirth.

# Dark Sky content resonates with Venturesome Travelers

Hot air balloon



Nambe



Santa Barbara  
Hiking



Skiing  
(challenging)



Skiing  
(groomers)



Snowshoeing



Natural  
hot spring



Sunset fisherman



White Sands  
nightscape



White Sands  
horseback



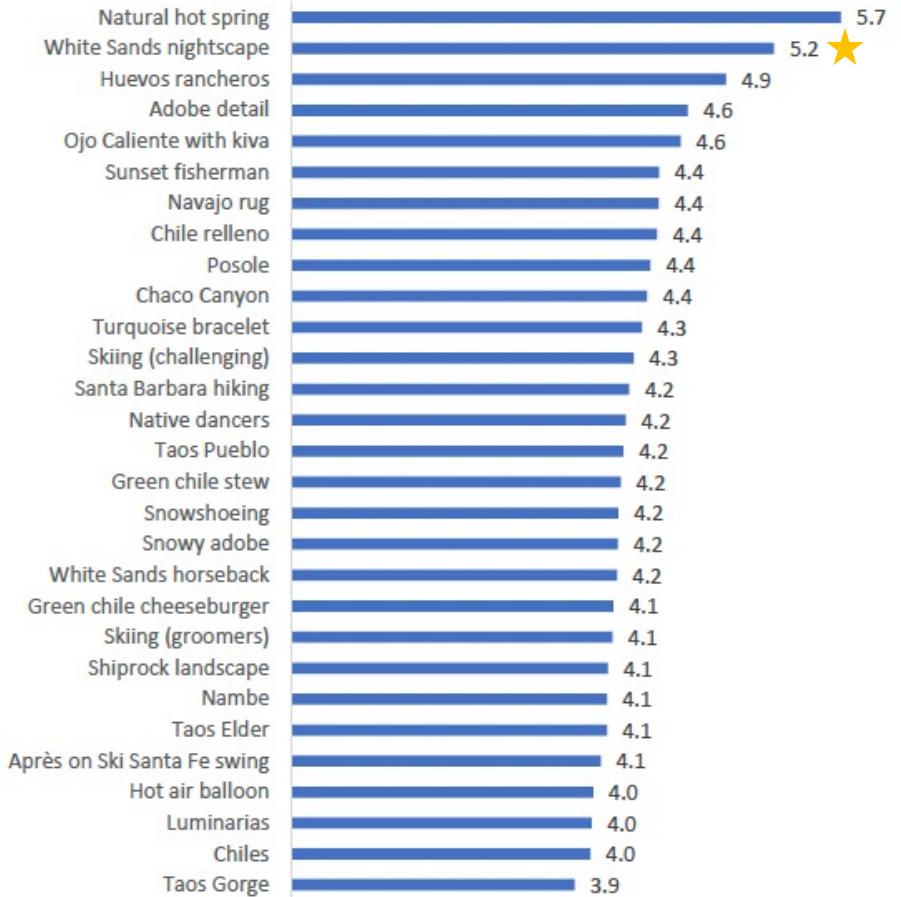
Shiprock landscape



Taos Gorge



Average time (seconds) spent on image

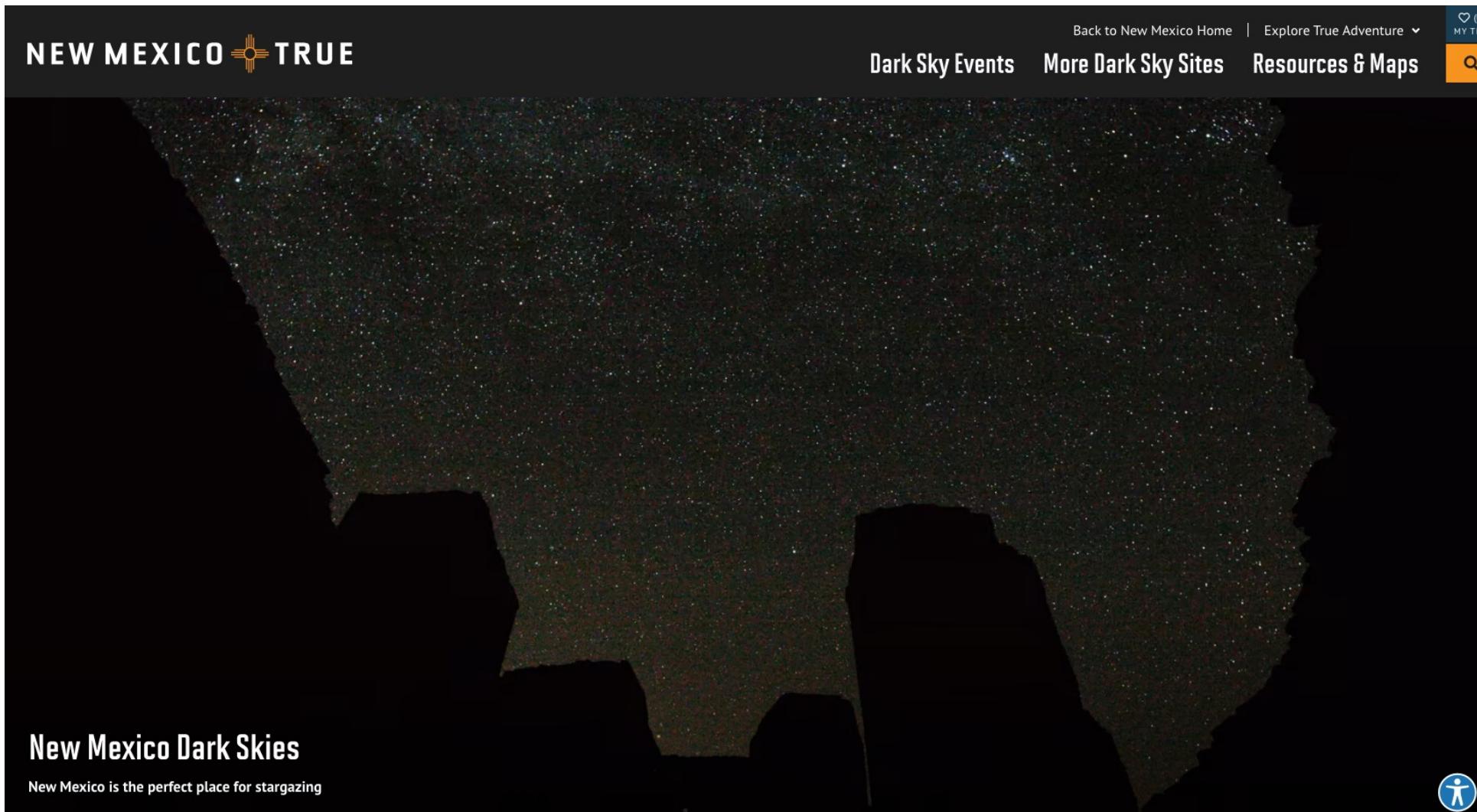


# New look New Mexico True through Dark Skies

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# Dark Skies on NewMexico.org



NEW MEXICO  TRUE

Back to New Mexico Home | Explore True Adventure ▾

Dark Sky Events More Dark Sky Sites Resources & Maps

Search icon

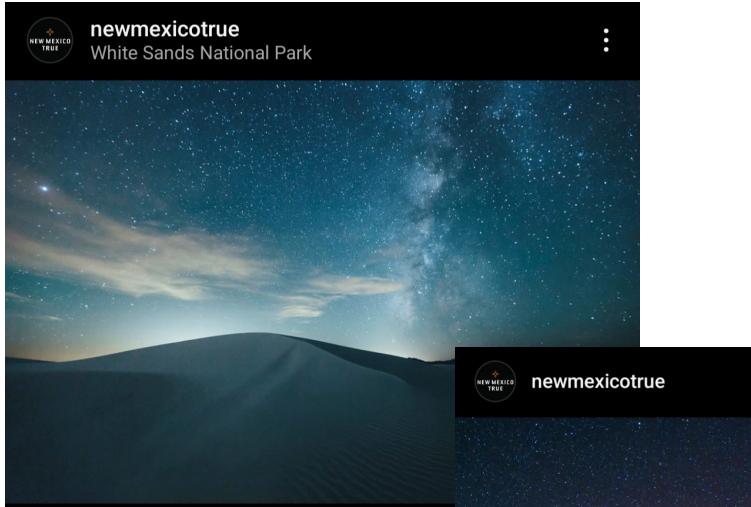
New Mexico Dark Skies

New Mexico is the perfect place for stargazing

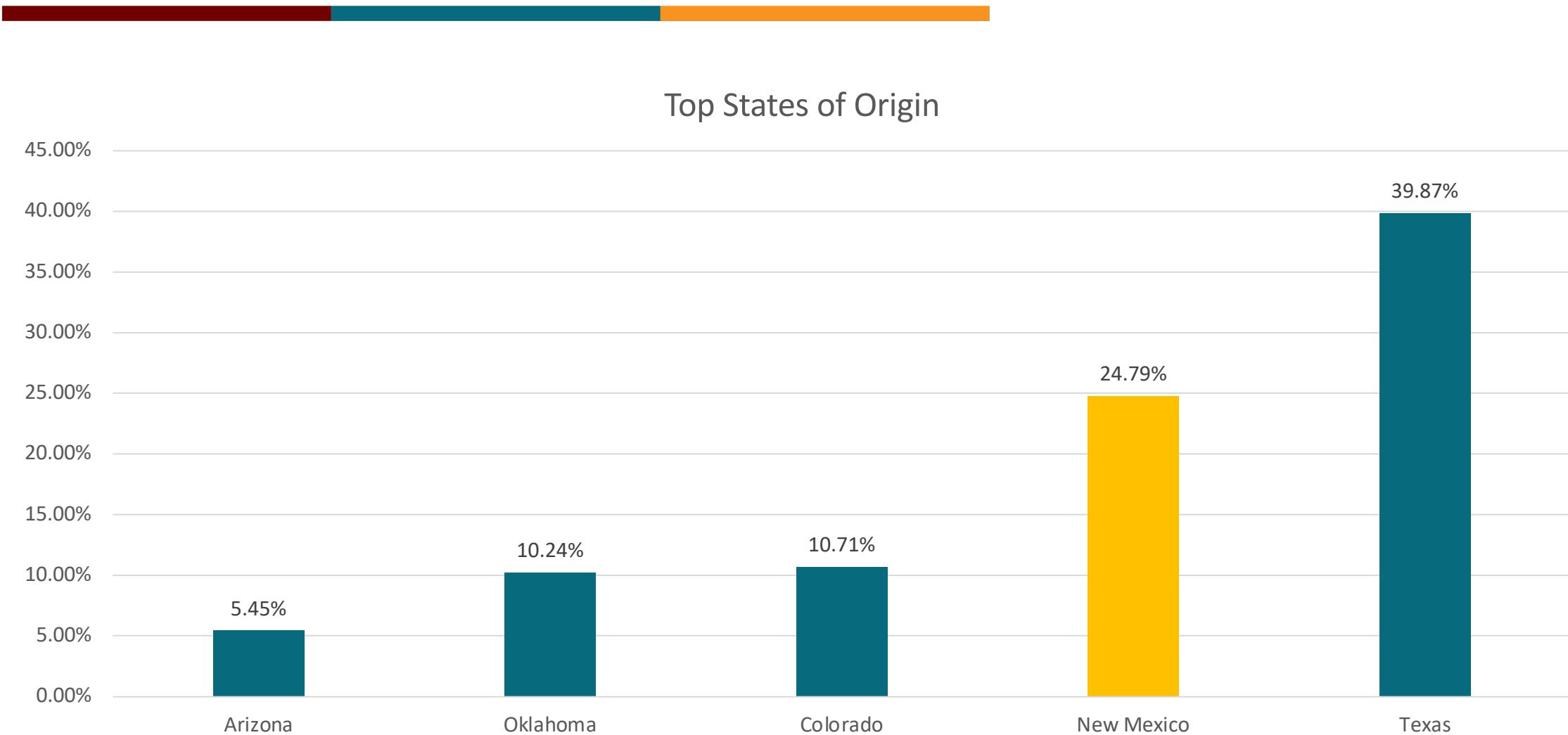
MY TRIP

Blue circular icon with a white stylized figure.

# Dark Skies on social media



# Visitation to Dark Sky Parks in New Mexico



# Programs and services with the Tourism Department

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## Destination Forward

Grant program that supports the planning, construction and renovation of tourism-related infrastructure



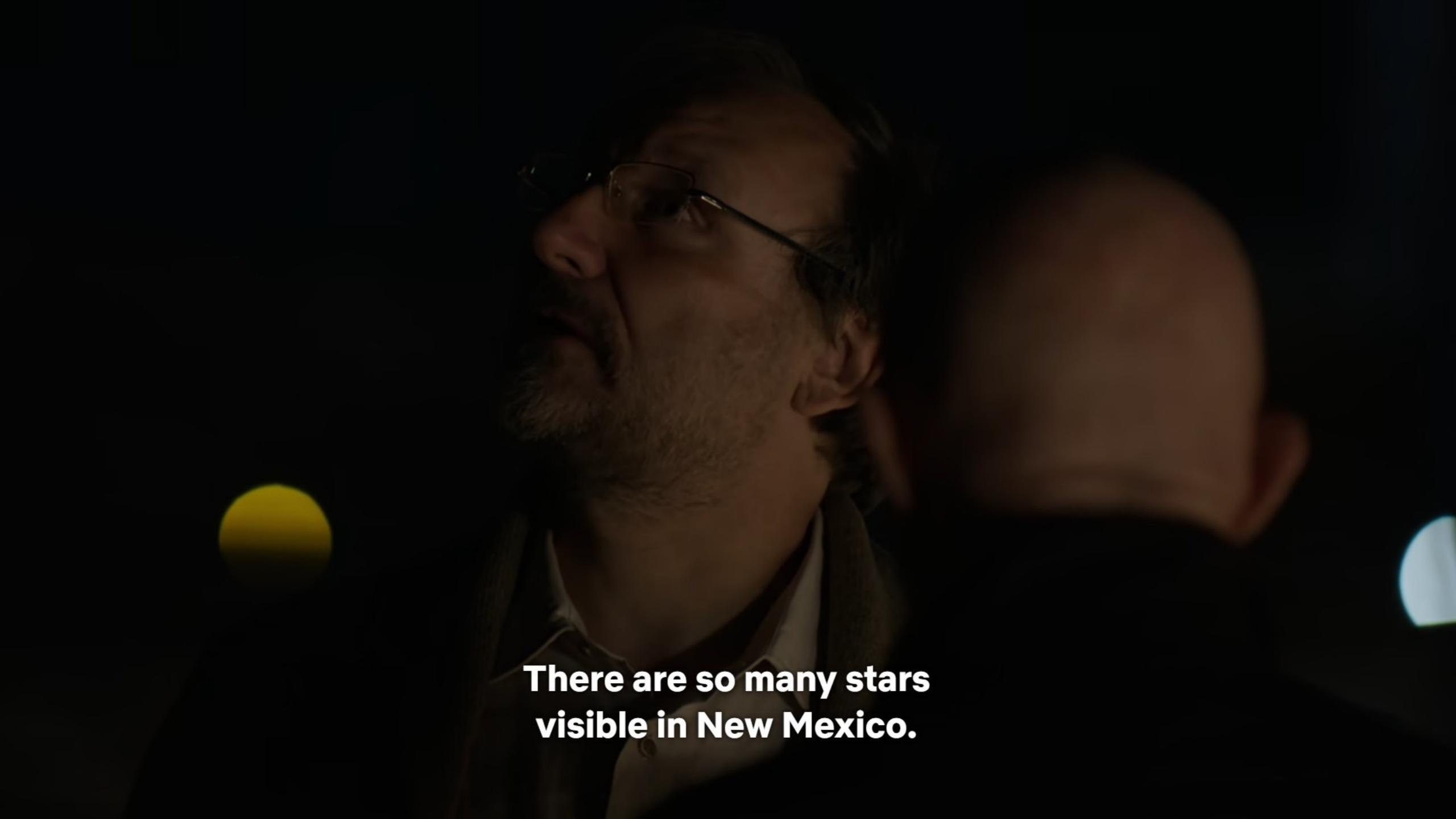
## Cooperative Marketing Grant Program

Grant program that pools resources with eligible entities to amplify advertising capabilities



## Website Listing

Local businesses, non-profits, artists and event planners can create business or event listings that will display on NewMexico.org

A close-up, low-key photograph of a man with glasses looking upwards and to his left. He has a beard and is wearing a dark shirt. The background is dark, suggesting a night sky, with a few small, bright circular lights visible on the left and right edges.

**There are so many stars  
visible in New Mexico.**

**Grady Owens : NM Skies**



# Private Astronomy Enterprise in New Mexico

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Grady Owens, New Mexico Skies

# New Mexico Skies: Mayhill, NM



© New Mexico Skies  
Paul Gearhart

# Other Private Dark Sky Sites

- Dark Sky New Mexico:  
Animas, NM
- Astronomers Paradise:  
Rodeo, NM
- Deep Sky West: Rowe,  
NM



**McKinney Briske : BLM**



# NATIONAL CONSERVATION LANDS

## BLM New Mexico: Night Skies

By McKinney Briske



What are your organization's interests in dark skies? Relevant background?

The BLM is responsible for more land than any other federal agency, approximately 245 million acres of public lands, predominantly in western states, including Alaska and approximately 710 million acres of subsurface mineral estate.

Outdoor lighting at night can cause light pollution, which is a growing public concern that can be addressed by following lighting best practices.

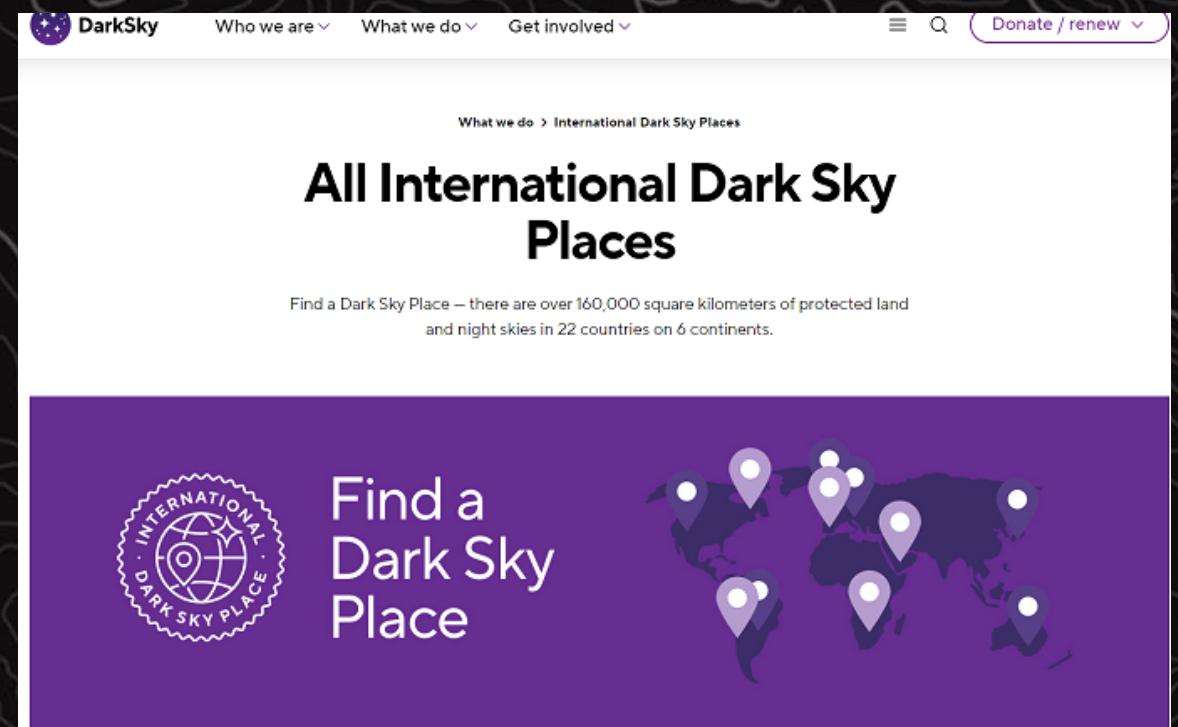
# What have your efforts been, if any, towards them? Future plans? Desires?



**BUREAU OF LAND MANAGEMENT**

 **Night Sky and Dark Environments:  
Best Management Practices for Artificial  
Light at Night on BLM-Managed Lands**

Technical Note 457



**DarkSky** Who we are ▾ What we do ▾ Get involved ▾ ☰ Q Donate / renew ▾

What we do > International Dark Sky Places

## All International Dark Sky Places

Find a Dark Sky Place — there are over 160,000 square kilometers of protected land and night skies in 22 countries on 6 continents.



**Find a  
Dark Sky  
Place**



# How can BLM contribute to a broader coalition for dark skies?

In accordance with the Federal Land Policy and Management Act (FLPMA), the BLM manages public lands for a variety of uses, including, but not limited to, livestock grazing, energy development, wildlife habitat, and outdoor recreation, while conserving natural, cultural, and historic resources. Section 102(a)(8) of FLPMA directs the BLM to manage the public lands “in a manner that will protect the quality of scientific, scenic, historical, ecological...and archeological values...and provide for outdoor recreation and human occupancy and use.” BLM-managed public lands are some of the least developed areas in the United States.

How can your group benefit from the contributions of others?...working together.



# **Peter Lipscomb : NM State Parks**

# New Mexico State Parks

Peter Lipscomb  
New Mexico State Parks  
505-474-0196  
[peter.Lipscomb@emnrd.nm.gov](mailto:peter.Lipscomb@emnrd.nm.gov)



# Reach for the Stars Program





**INTERNATIONAL DARK-SKY PARK  
DESIGNATION (GOLD LEVEL)**

**CLAYTON LAKE STATE PARK  
NOMINATION PACKET**



Star Point Observatory: Clayton Lake State Park

A proposal to:

**The International Dark-Sky Association**

3225 N. First Avenue  
Tucson, Arizona 85719

**John Winscott / Brian McLoughlin :  
State Lands Office**

**Zandra Fleming : NMOGA**

**Brian Jensen : Santa Fe Conservation Trust**

# Santa Fe Conservation Trust



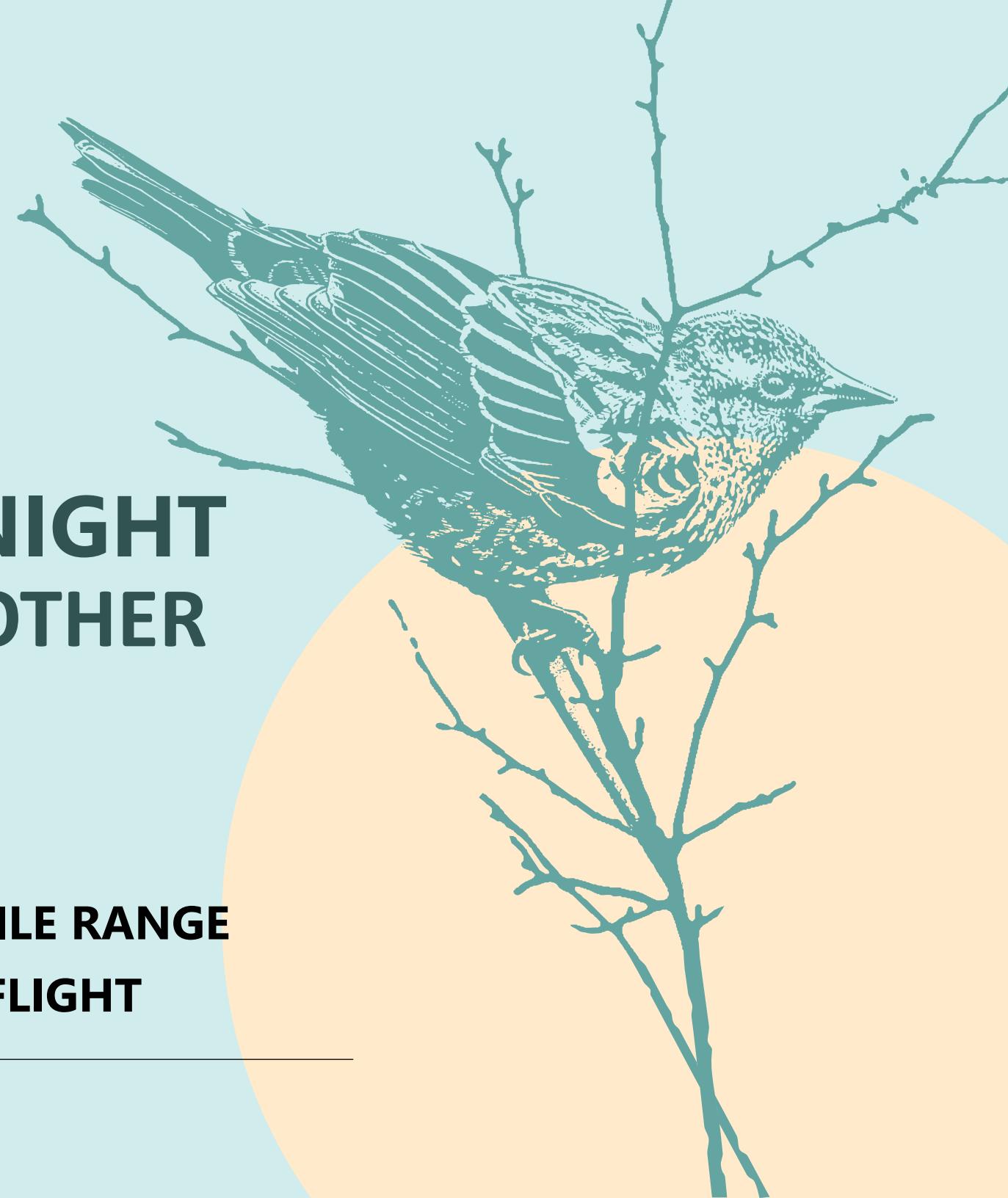
- Founded in 1993
- Mission: "The Santa Fe Conservation Trust partners with our community to keep northern New Mexico's living lands and people flourishing together. We protect culturally and environmentally significant landscapes, ignite people's passion for nature and enable the continual regeneration of our healthy place."
- Vision: We envision a future where everyone in northern New Mexico cherishes nature and works to preserve it for this and future generations.
- 46,000+ acres preserved
- SFCT, Community Conservation, and Dark Skies:
  - Dark sky conservation is land and habitat conservation!
  - Conservation Easements (compliance with NM's Night Sky Protection Act)
  - Community Star Parties
  - Night Sky Monitoring Project
  - Public Outreach (TBD)
- Check us out at [www.sfct.org/darks skies](http://www.sfct.org/darks skies) for more information about our programs and calendar.

**Trish Cutler : WSMR/DoD/Audubon**

# **ARTIFICIAL LIGHT AT NIGHT BIRDS AND OTHER ANIMALS**

**TRISH CUTLER  
WHITE SANDS MISSILE RANGE  
DOD PARTNERS IN FLIGHT**

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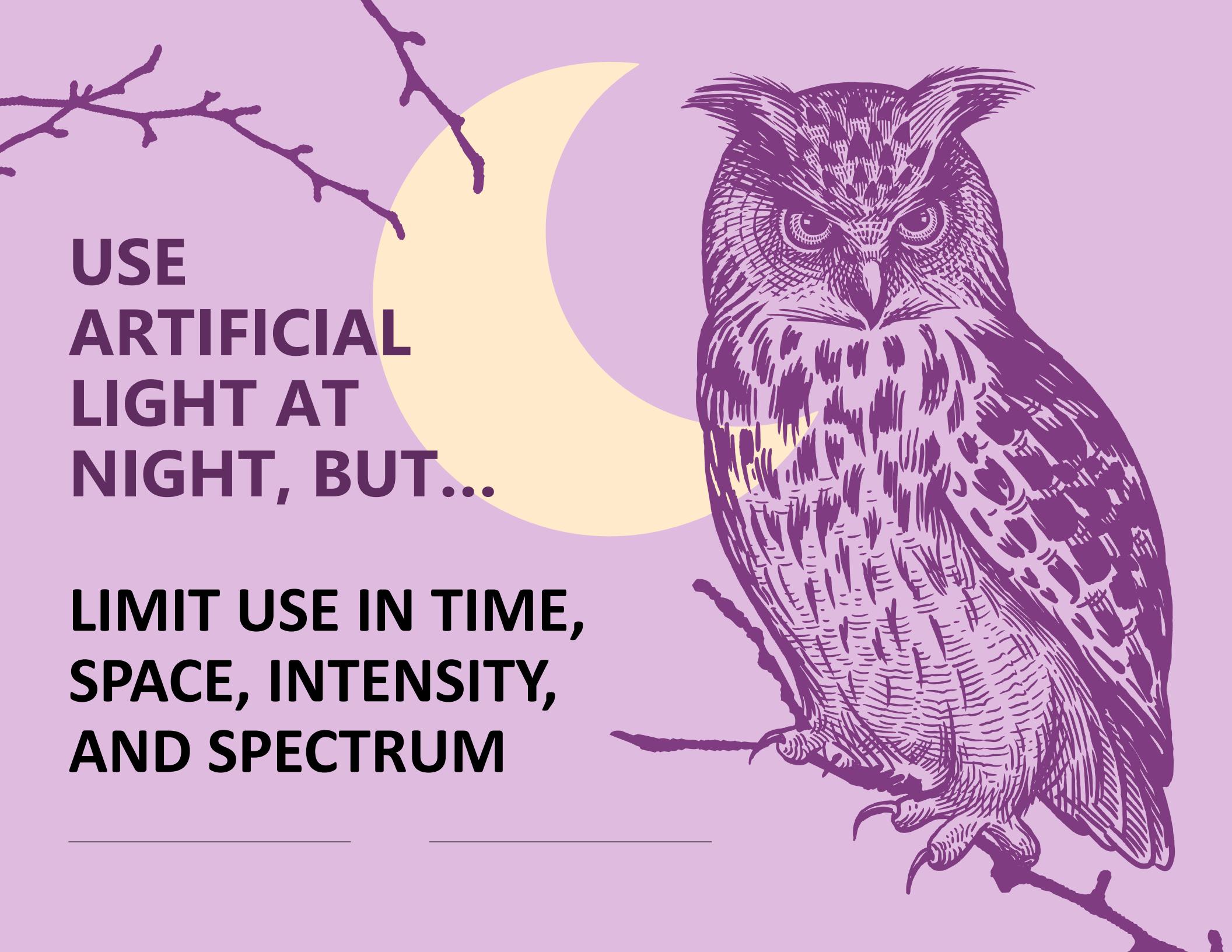
# Impacts to Birds and other Animals

## Spring/Fall Bird Migration

- Skyglow affects navigation
- Change in migration timing
- Attraction and capture/collision (buildings, floodlights, tower lighting)

## Beyond Bird Migration

- Habitat avoidance
- Change in circadian rhythms
- Change in metabolism
- Other phenology shifts
- Altered predator/prey relationships



**USE  
ARTIFICIAL  
LIGHT AT  
NIGHT, BUT...**

**LIMIT USE IN TIME,  
SPACE, INTENSITY,  
AND SPECTRUM**



# Tilt and Light Quality

## CREE LIGHTING

### OSQ™ Series



#### The OSQ Series Flood luminaire blends extreme optical control, advanced thermal management and modern aesthetics.

The rugged cast aluminum housing is built to last with a weathertight LED driver compartment. Versatile mounting options offer simple installation. Its slim low-profile design minimizes wind load requirements and blends seamlessly.

10 YEAR WARRANTY

DARK SKY APPROVED

HIGH CRI OPTIONS

HIGH EFFICACY OPTIONS

DLC PREMIUM

VERSATILE MOUNTING



**OSQ™ LED Area/Flood Luminaire featuring Cree TrueWhite® Technology – Extra Large**

**Product Specifications**

**SNAP™ INDUSTRIAL AREA/FLOOD LUMINAIRES**

A Cree TrueWhite® Technology area/flood luminaire in a highly durable, weatherized lighting solution featuring new shaping, intense coloring, and bright harnessing with ultra-grade power and reliability. The luminaire is designed for industrial, commercial, and outdoor applications such as parking garages, stadiums, arenas, and more. The new Cree Lighting Controller (CLC II or CLC III) provides accurate color reproduction, a wider color gamut, and a better light experience.

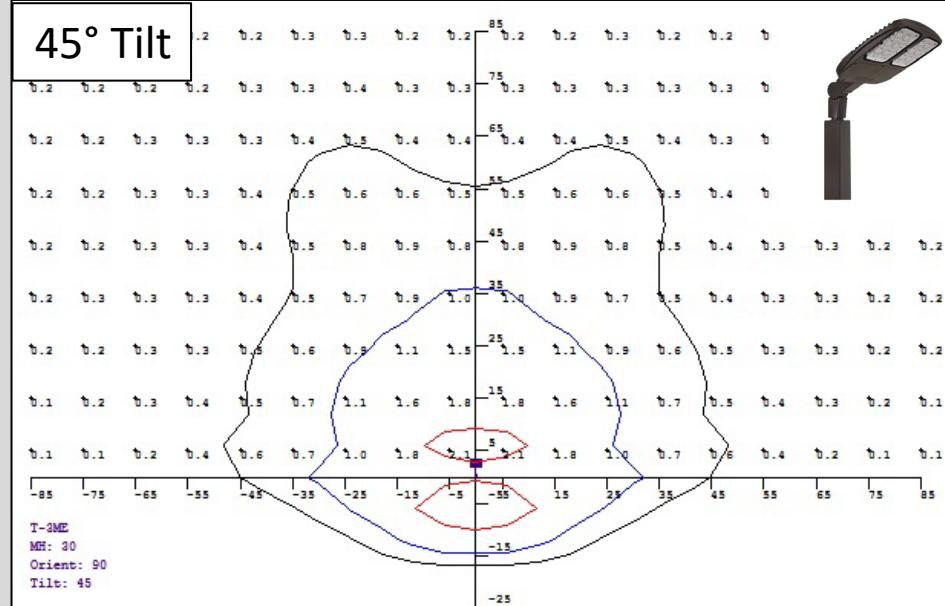
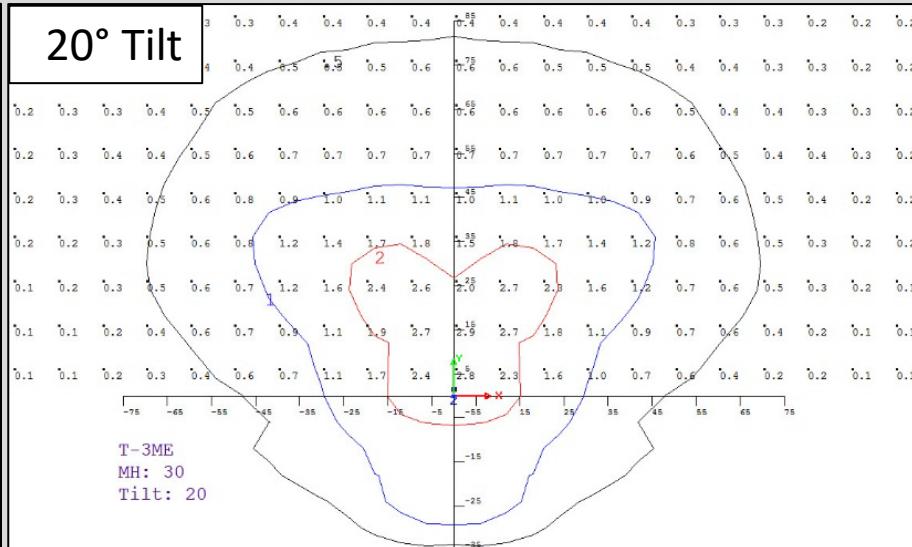
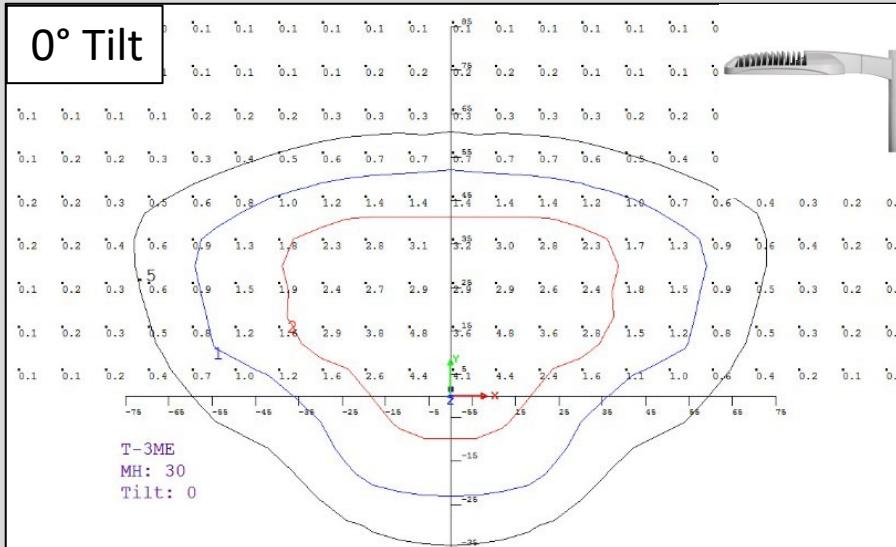
**Screen: Wireless Control**

Screen	Wireless Sensor	Model	Color Temp	Power	Driver	Mount	Mounting	Wattage	Beam Angle	Mounting	Wattage	Beam Angle
SNAP™	SNAP™	SNAP™	3000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	4000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	5000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	6000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	7000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	8000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	9000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	10000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	11000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	12000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	13000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	14000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	15000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	16000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	17000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	18000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	19000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	20000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	21000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	22000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	23000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	24000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	25000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	26000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	27000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	28000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	29000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	30000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	31000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	32000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	33000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	34000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	35000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	36000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	37000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	38000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	39000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	40000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	41000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	42000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	43000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	44000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
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SNAP™	SNAP™	SNAP™	46000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
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SNAP™	SNAP™	SNAP™	49000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
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SNAP™	SNAP™	SNAP™	53000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
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SNAP™	SNAP™	SNAP™	59000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	60000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
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SNAP™	SNAP™	SNAP™	97000K	100W	100W	SNAP™	SNAP™	100W	120°	SNAP™	100W	120°
SNAP™	SNAP™	SNAP™	98000K	100W</								



# And Furthermore...

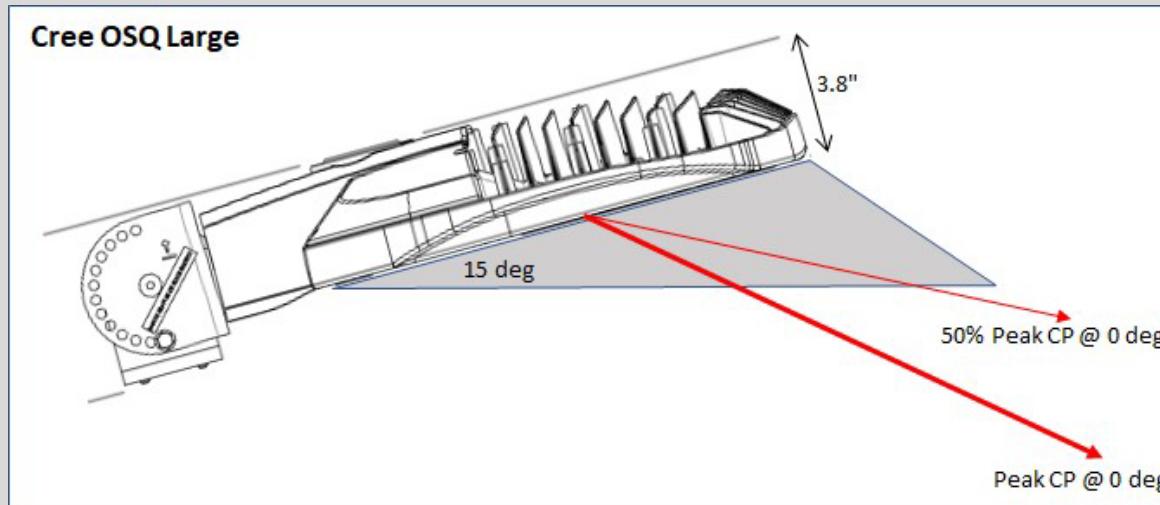
**TIlt Creates Low Quality Light!**





# Shield Development: Outer Fixtures

- Retrofit shield designed, prototyped by EDM,
- Produced & installed by WSMR
- Allow outward glare
- Prevent any direct uplight



**Anna Walker : NM BioPark**

# Impacts of Light Pollution on Insects

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## Individual-level Impacts

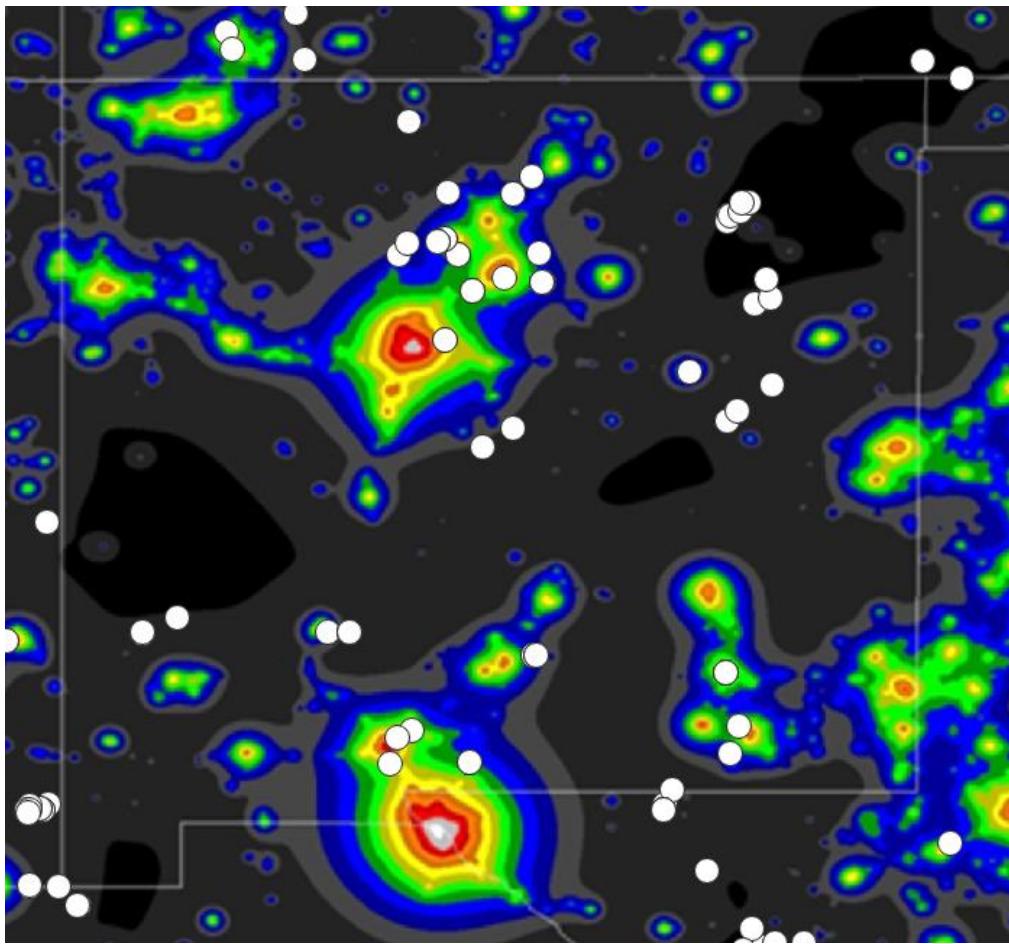
- Temporal disorientation
- Spatial disorientation
- Fatal attraction
- Temporary blindness

## Ecosystem-level Impacts

- Reduced abundance and diversity of nocturnal insects.
- Loss of food biomass for other wildlife.
- Reduced pollination rates.
- Mismatches between mutualistic species.

Anna Walker  
[\(anna@bioparksociety.org\)](mailto:(anna@bioparksociety.org))





Light Pollution Base Map: David Lorenz ([darkskym.org](http://darkskym.org))



# Invertebrate and Dark Sky Conservation

Xerces Society mission is to conserve invertebrates and their habitat

- Pollinator Conservation in Southwest Region
- Outreach to many communities in New Mexico
- Contribute invertebrate ecology messages or review to any policies, guidance, or educational resources
- Include pollinator and invertebrate conservation messages in dark sky advocacy



Photo: Xerces Society

Kaitlin Haase, Kaitlin.haase@xerces.org

# **Catherine DeMaria / Marisela La Grave : Dark Sky Land**

# Dark Sky Land New Mexico Logo Study

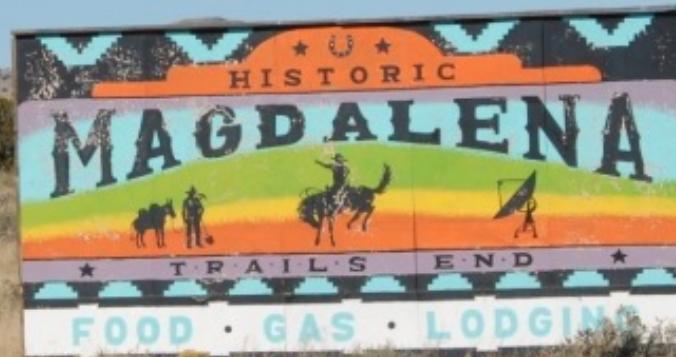






# **John Briggs : Astronomical Lyceum**

TOR  
TER  
FILE  
EAD



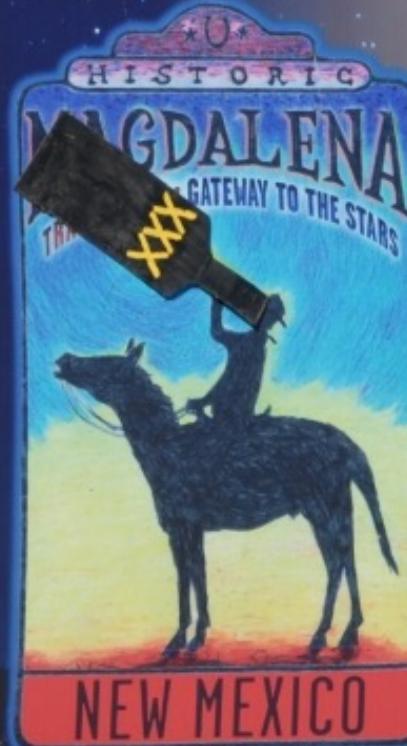




# WELCOME

"They don't  
make places  
like this anymore"

34°07'01.2"N 107°14'48.9"W



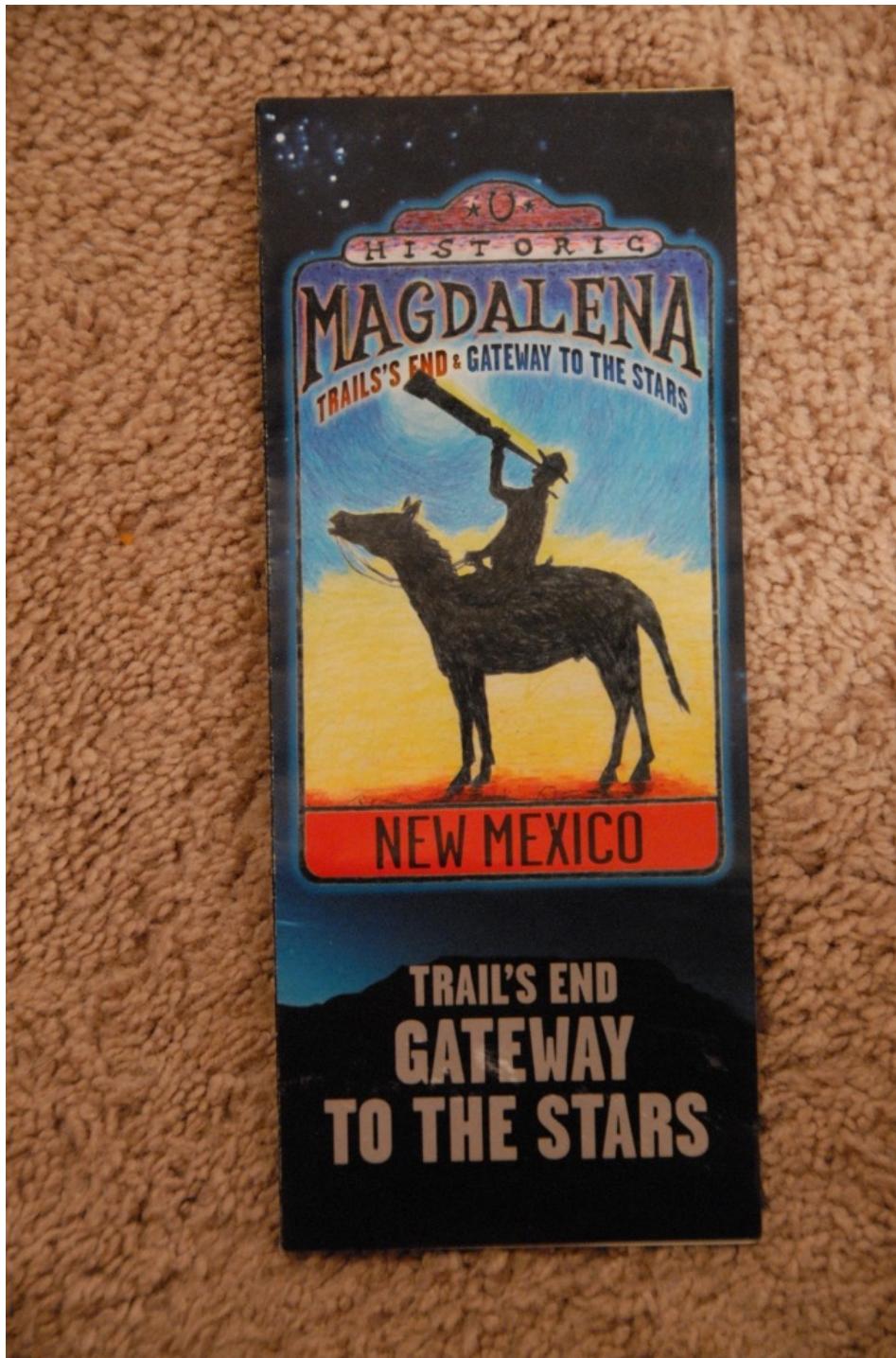
Gas • Cafes  
Lodging • Camping  
Galleries • Hunting

Saloon

- RODEOS
- VERY LARGE ARRAY / MRO
- KELLY MINE • STAR PARTIES
- OLD TIMERS' REUNION



Robert C. Eganite



**Antoine Ribaut: Magdalena Astronomical Society**

**Eileen Ryan :  
New Mexico Tech / Magdalena Ridge Observatory**

# Overview of NM Professional Astronomy



Dr. Eileen V. Ryan  
*(NM Tech/Director, Magdalena Ridge Observatory 2.4-meter Telescope)*



# NM Tech: Astronomy

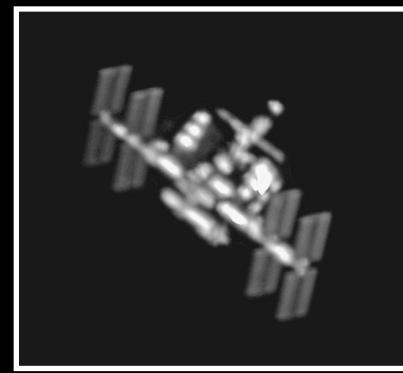
*Magdalena Ridge 2.4m Telescope: Operational since 2007*



Limiting Magnitude V~24.5



NASA PDO NEOs



Space Domain Studies



DART SC Mission

*Magdalena Ridge Optical Interferometer: Under Development*

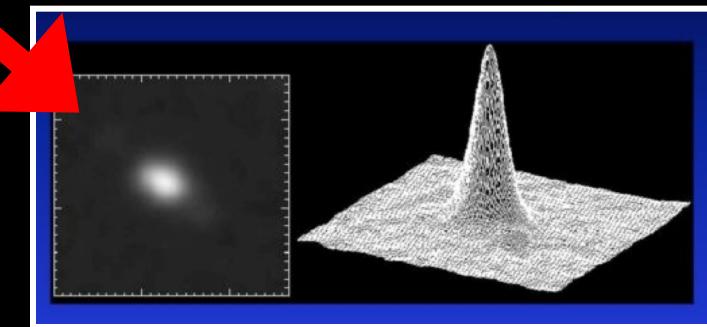
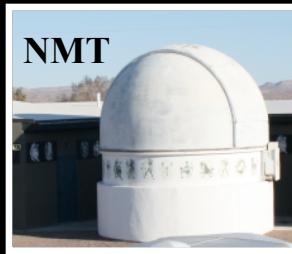


Ten 1.4m diameter movable telescopes on array spanning 8-347 meters in baseline

Dark Sky needs: 14th mag in near-IR; ~17th mag in visible



# Campus Observatories



*Dark skies make the state competitive for projects relying on faint object research and educational programs.*

# Enforcing the Night Sky Protection Act

- Positive conversations with City Council members to limit impact of athletic field lighting, LED billboards, construction of super centers, hospitals, etc.
- NMSU/NMT: Dark Skies needed for protecting the research-dollar investment in these sites (economic impact, too). Further: both universities have graduate programs that rely on dark skies.
- NMSU/NMT: Have active public education outreach programs. Thousands/year attend nighttime events.
- Continuing threats to dark skies: Albuquerque, El Paso, and lights of Kirtland/Holloman Air Force Bases.

# **Robert Johnson : Starfire Optical Range**



U.S. AIR FORCE



# AFRL

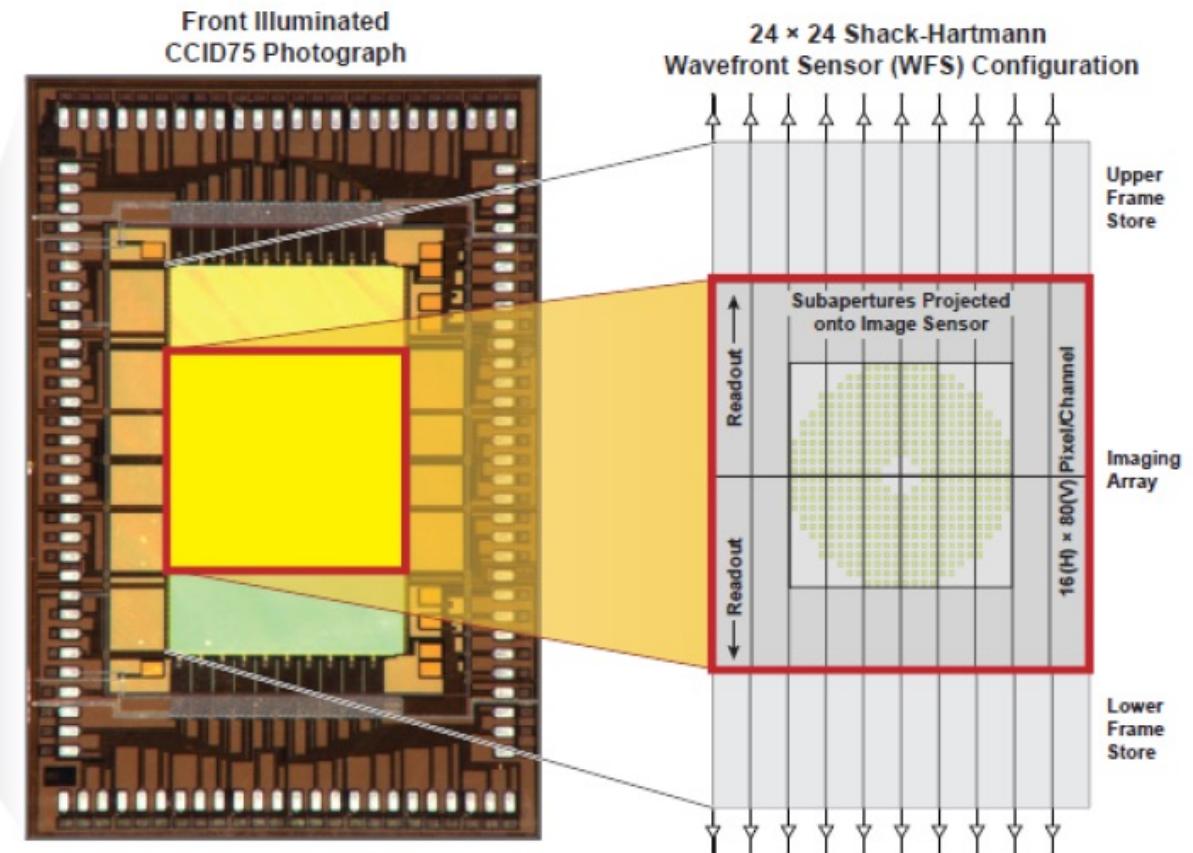
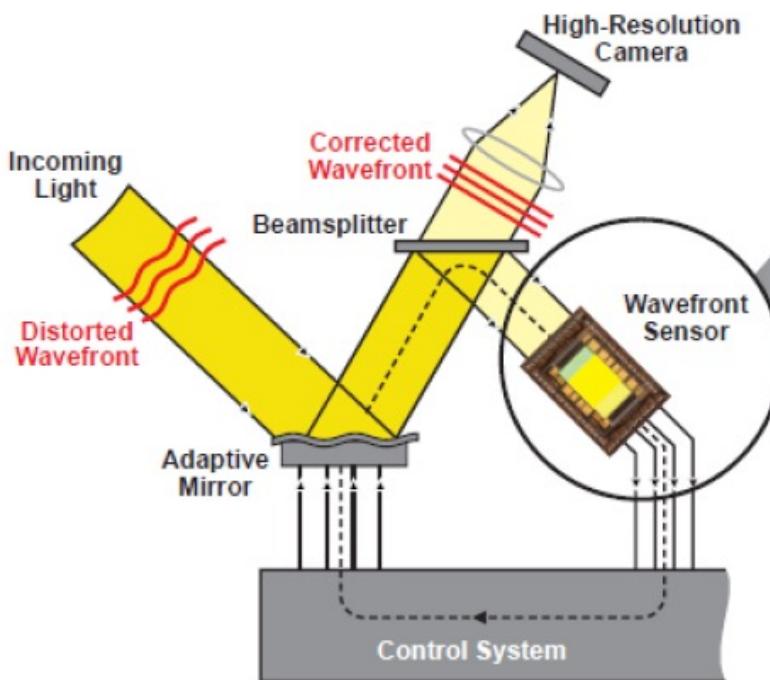
# Laser-beacon adaptive optics

Robert Johnson, PhD

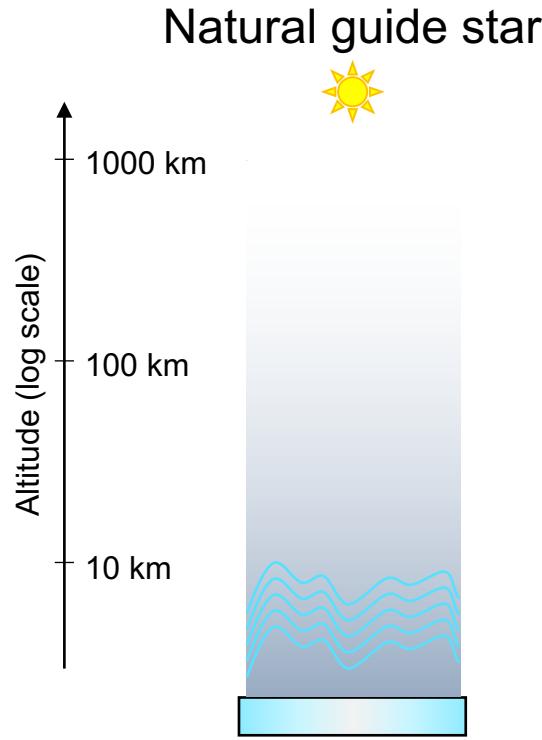
Starfire Optical Range 2023-12-01

# Adaptive optics and wavefront sensing

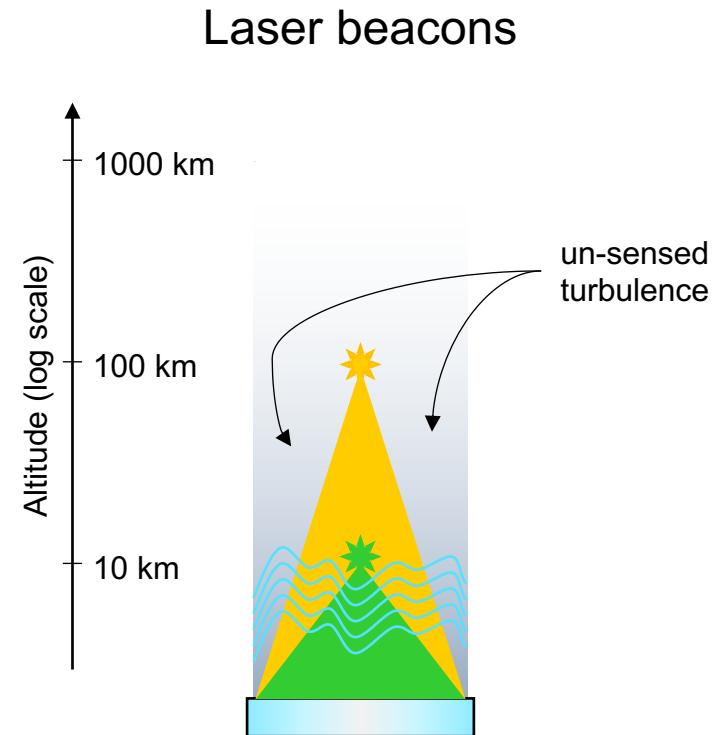
Adaptive optics work by measuring atmospheric turbulence induced distortion of a telescope's image and correcting these distortions using deformable optics. A critical component of this system is the wavefront sensor, which is used to measure the optical distortion. The speed and accuracy of this sensor are critical bounds on the performance limits of an adaptive optics system.



# Laser beacons



- Light from distant object (star or satellite lit by sun)
- Fully samples air above telescope
- Limited to brighter objects
- Does not allow arbitrary pointing



- Light from laser beacon
- Partially sample air above telescope
- Allows imaging of dimmer objects
- Allows arbitrary pointing

# Low-earth orbit satellite

- SEASAT
- NASA, JPL
- Launched in 1978
- 800 km orbit altitude



AO OFF, TRACKING OFF



AO ON, TRACKING ON

# Morning Breakout Session :

- How can we broaden our coalition? Target groups/contacts
  - How can we best work together towards joint goals?
  - What are some large scale goals / dreams ! (specifics this afternoon!)
  - Large scale challenges
- 
- 10-15 minutes discussion
  - Quick report back