

A long-exposure photograph of a night sky showing numerous circular star trails in shades of blue, purple, and white. The trails are centered around a point in the sky, likely the North Star. In the foreground, the dark silhouettes of rocky terrain and trees are visible against the horizon.

# 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







noctalgia

*noun*

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

to be best in  
point of view.

**Paradigm** ['pær  
typical example.  
accepted perspe  
discipline at a g



finding value in darkness



people





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.
- Certifies 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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## Policy makers

Enact and enforce effective outdoor lighting policies



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## Lighting industry

Prioritizes DarkSky approved products, designs, and installations





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



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Enact and enforce effective outdoor lighting policies



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## Retailers

Wide availability of DarkSky  
Approved lights



## Lighting industry

Prioritizes DarkSky approved  
products, designs, and installations



## Consumers

Purchase and install DarkSky  
Approved products and devices.



## 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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## Retailers

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Approved lights



## Lighting industry

Prioritizes DarkSky approved  
products, designs, and installations

# 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 Nacional du Mt. Tremblant | Park | Canada

Xichong | Community | China    Bee Cave | Community | USA

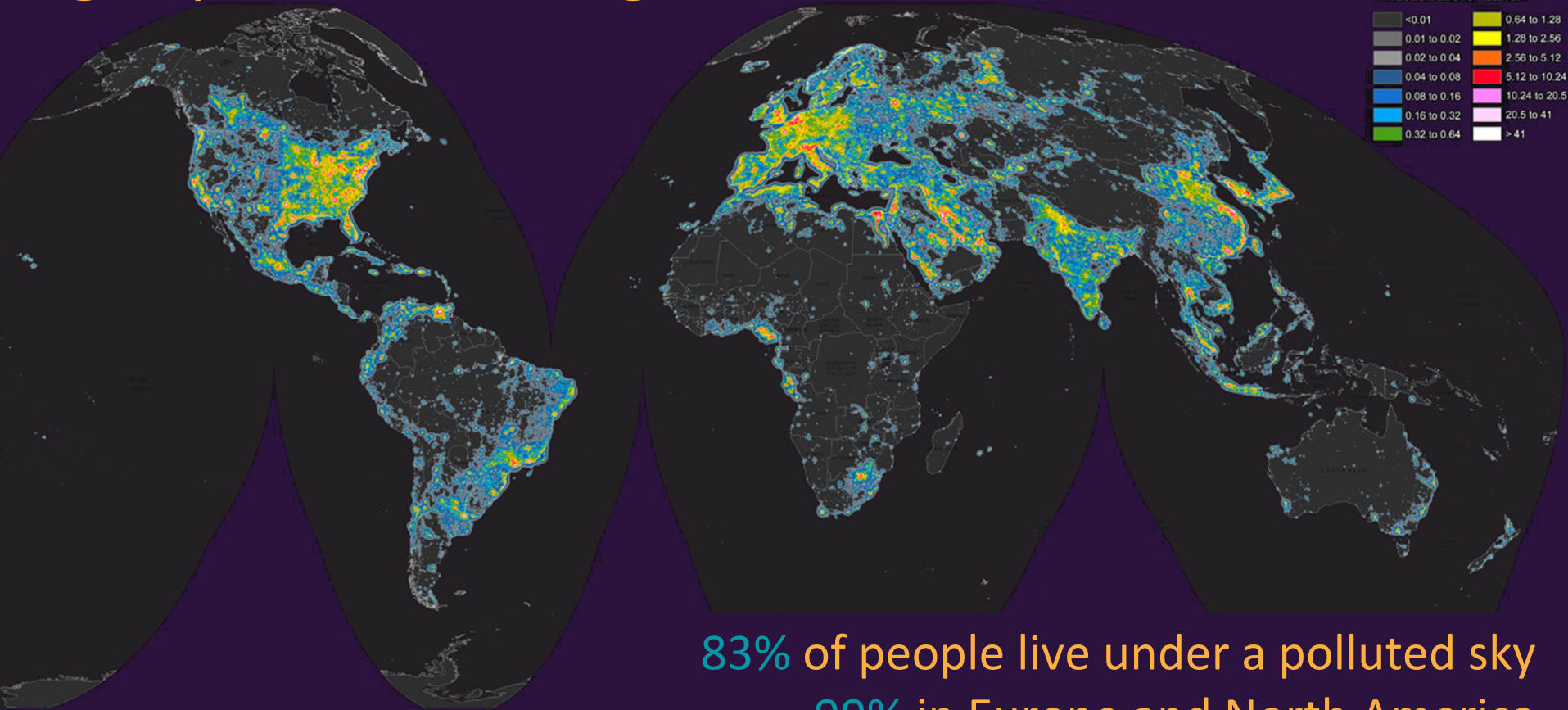
Arkaroola | Park | Sanctuary





What about New Mexico?

# Light pollution is a global issue....

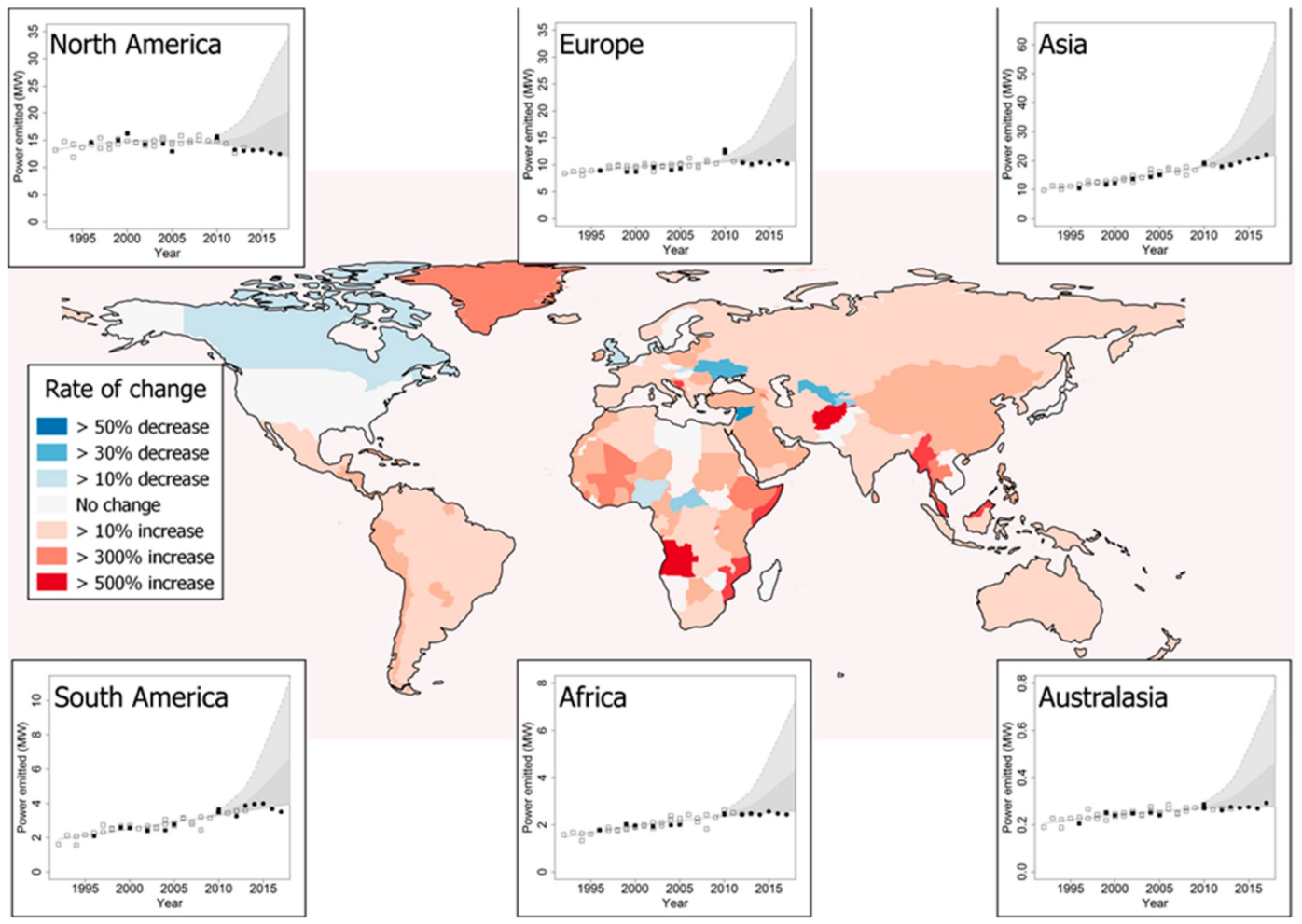


83% of people live under a polluted sky  
99% in Europe and North America

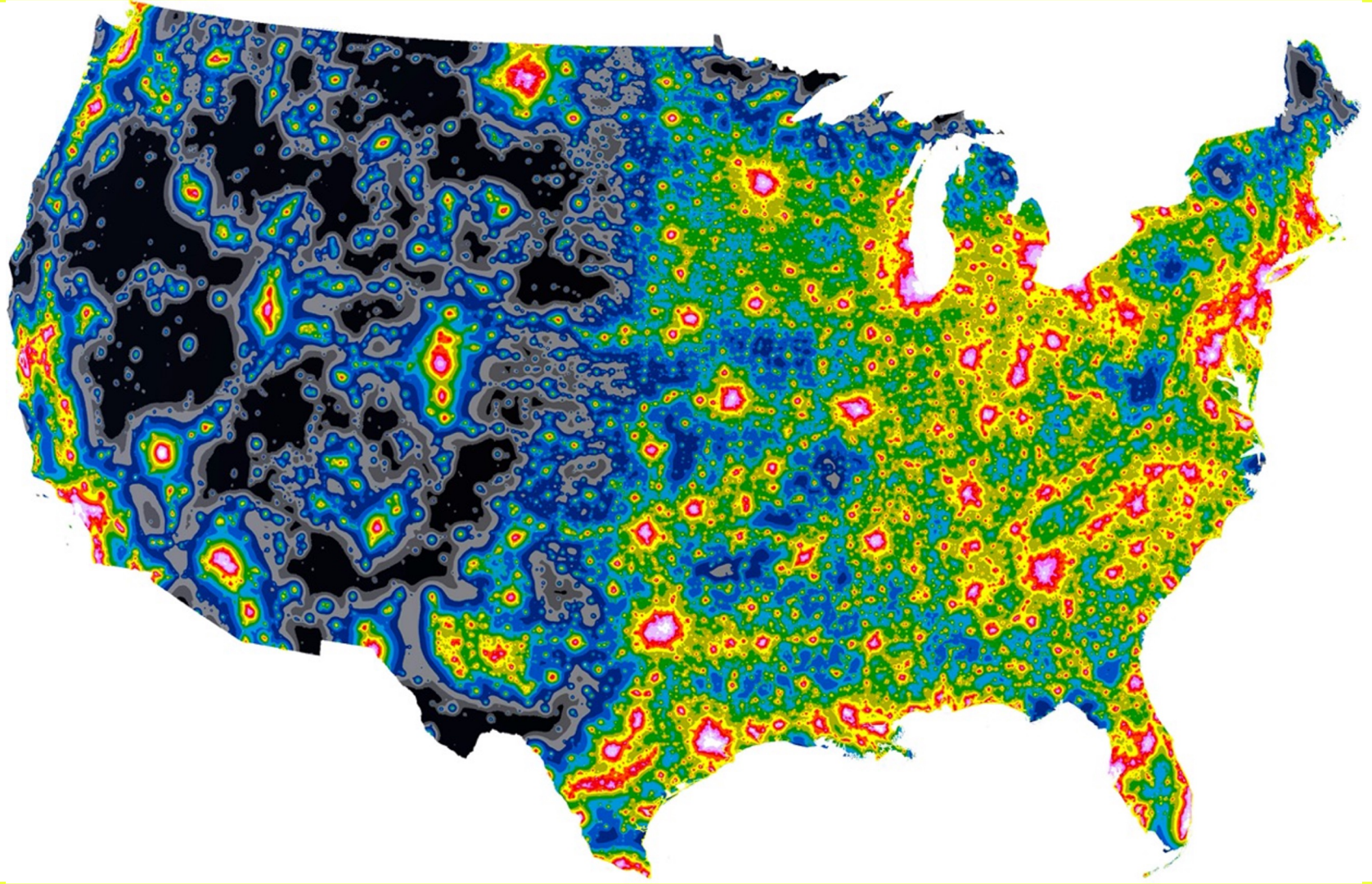
....it is growing, globally.

49% globally  
400% some regions  
over past 25 years

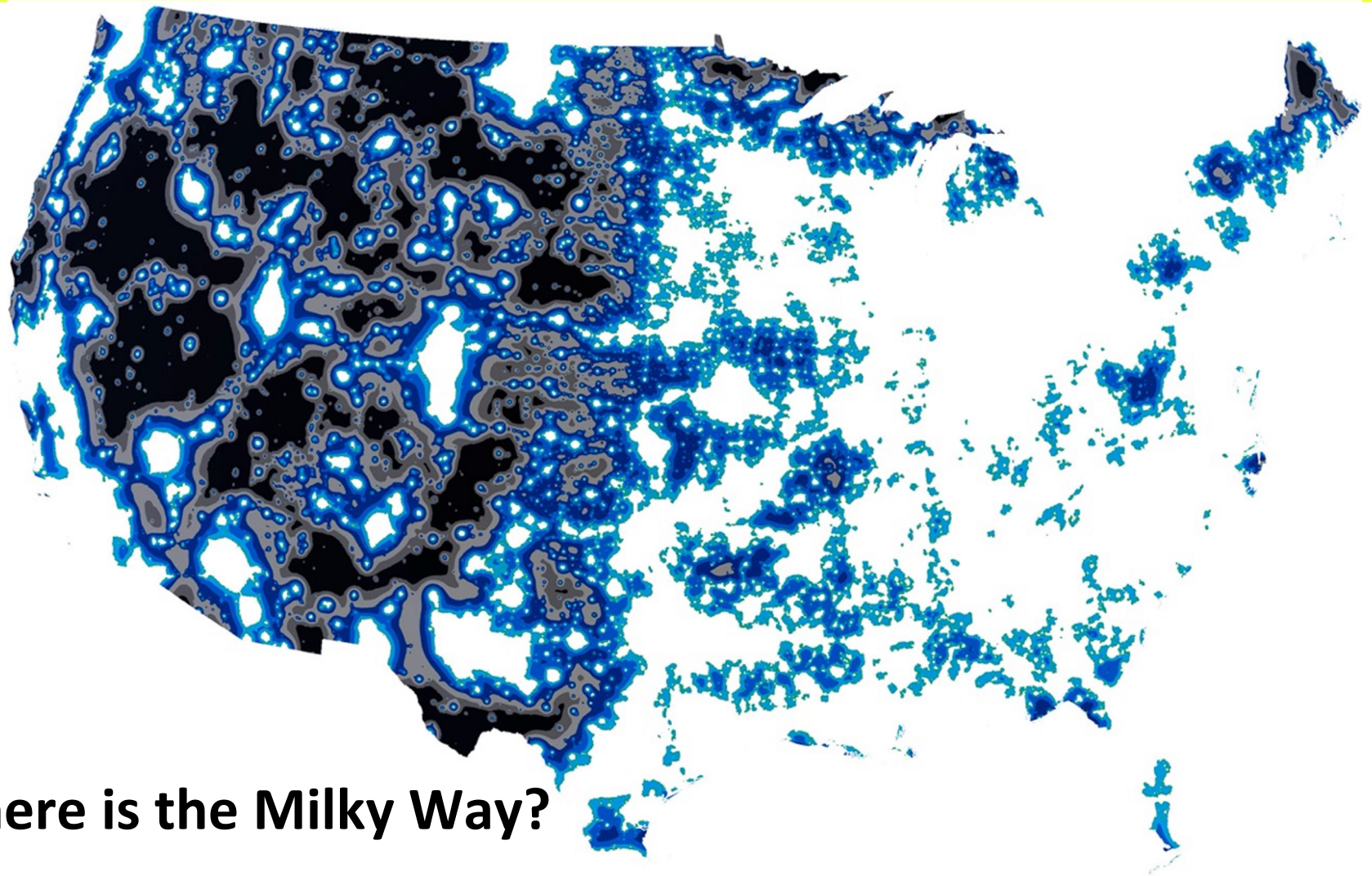
10% per year for past decade \*











**Where is the Milky Way?**



**Where do pristine night skies remain?**

New Mexico is special!



New Mexico DarkSky Places

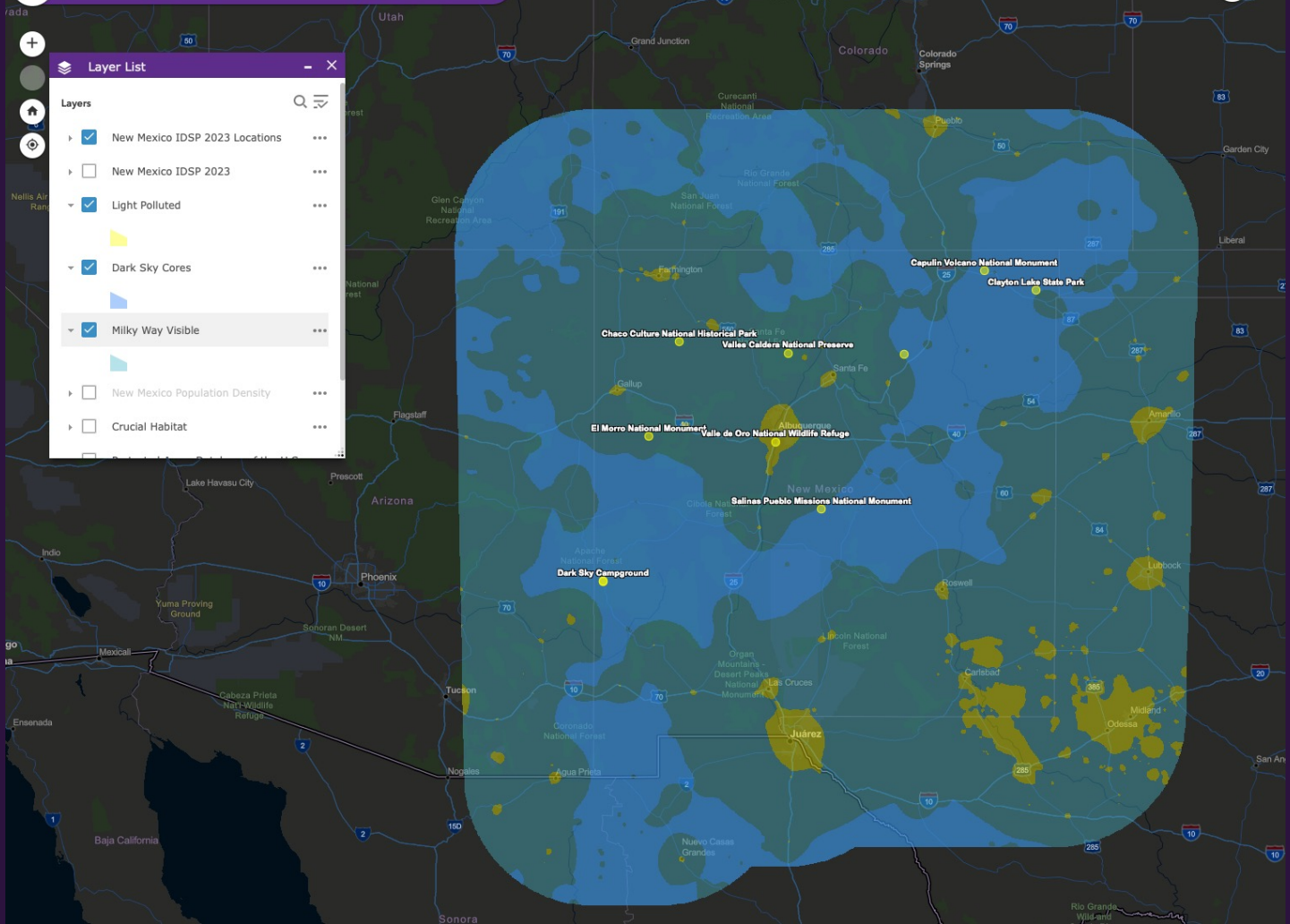
Find address or place



**Layer List**

**Layers**

- New Mexico IDSP 2023 Locations ...
- New Mexico IDSP 2023 ...
- Light Polluted ...
- Dark Sky Cores ...
- Milky Way Visible ...
- New Mexico Population Density ...
- Crucial Habitat ...



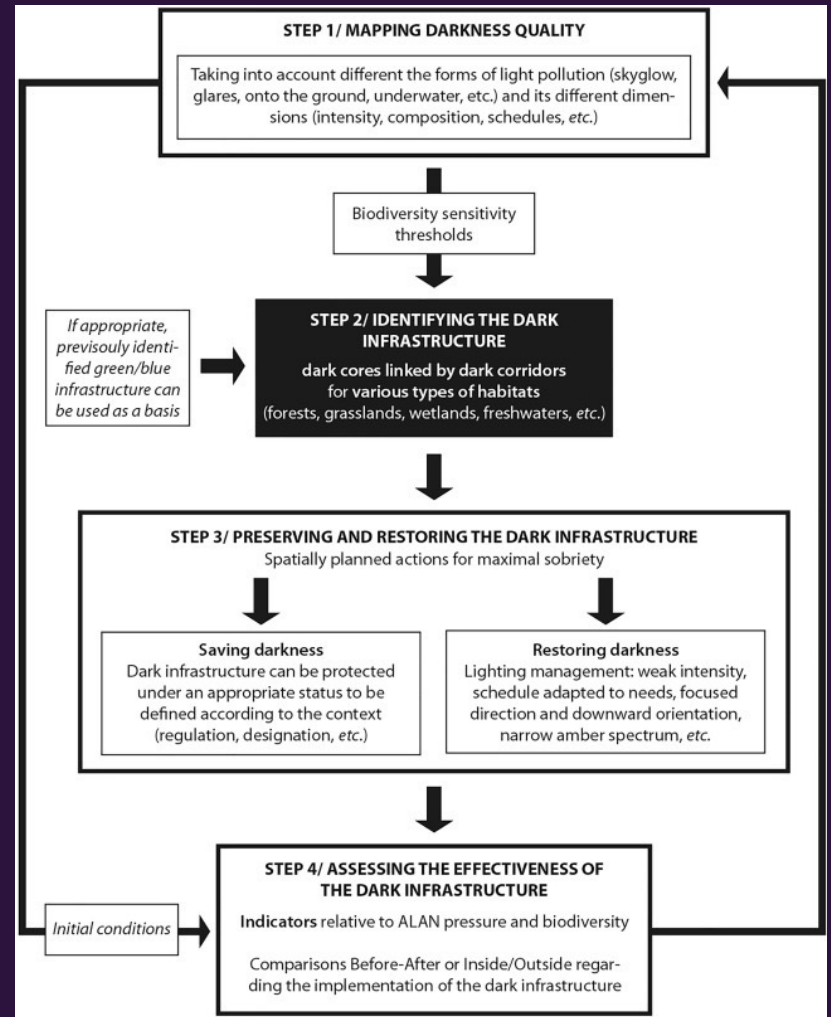
# Dark infrastructure

*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 International

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

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

# Morning presentations : building a broad coalition for dark skies

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**Cody Johnson : NM True**



**NEW MEXICO**  **TRUE**



# 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



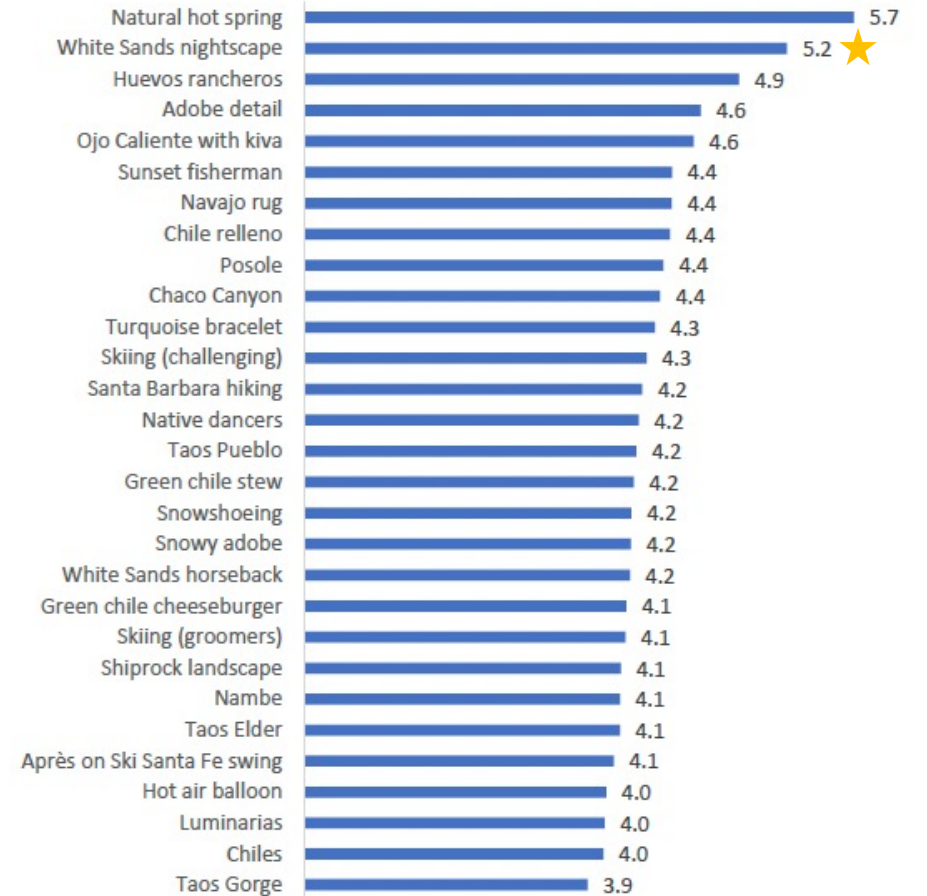
Shiprock landscape



Taos Gorge



Average time (seconds) spent on image

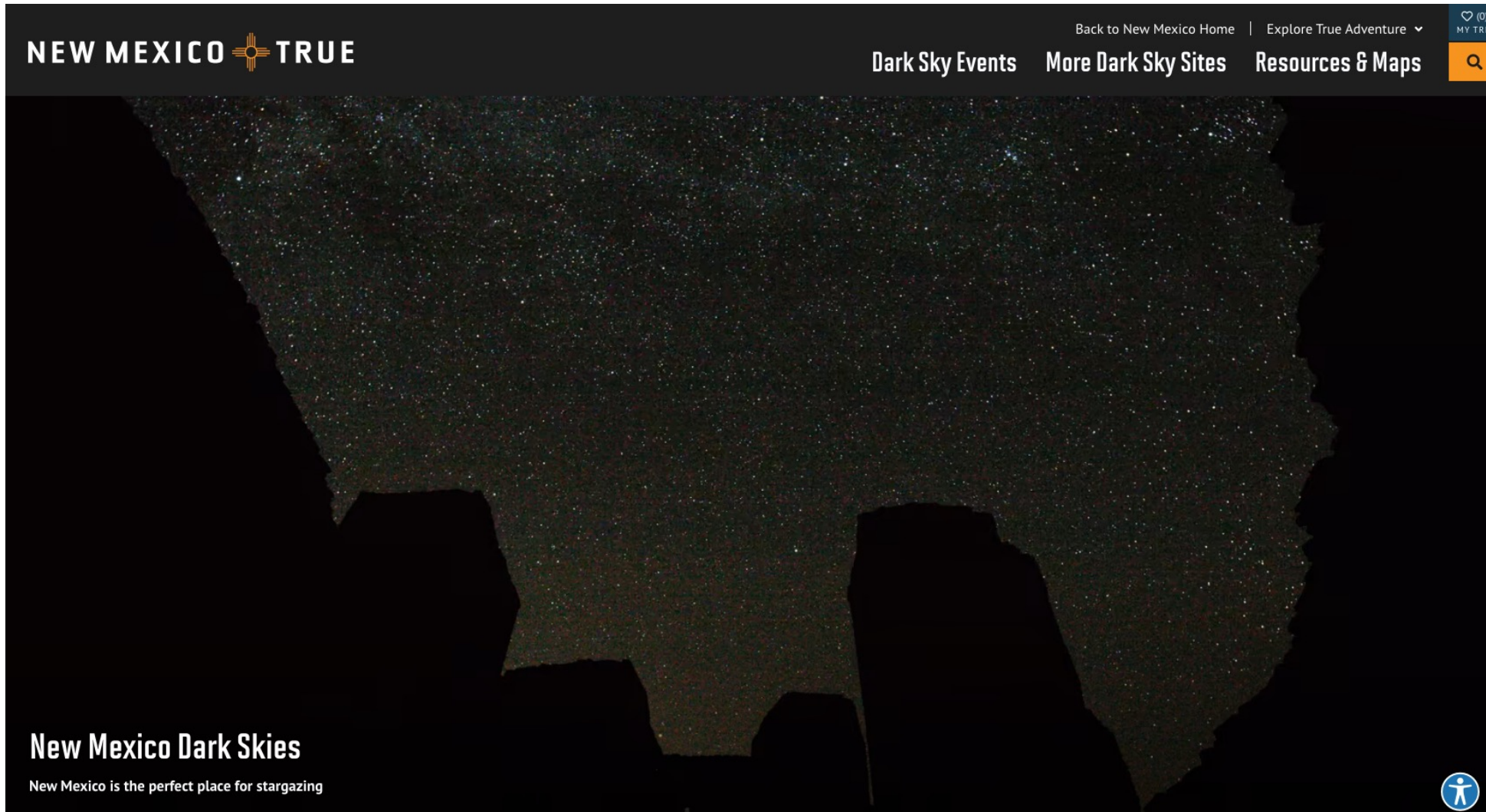


# New look New Mexico True through Dark Skies








# Dark Skies on NewMexico.org




The screenshot shows the top portion of a website. At the top left is the logo "NEW MEXICO TRUE" with a stylized sun symbol between the words. To the right of the logo are navigation links: "Back to New Mexico Home", "Explore True Adventure" with a dropdown arrow, and "Dark Sky Events", "More Dark Sky Sites", and "Resources & Maps". Further right is a "MY TRIP" button with a heart icon and "(0)", and a search button with a magnifying glass icon. The main content area features a large, dark image of a starry night sky over a silhouette of a desert landscape with jagged rock formations. In the bottom left corner of this area, the text "New Mexico Dark Skies" is displayed in a bold font, with the tagline "New Mexico is the perfect place for stargazing" underneath it. In the bottom right corner of the image area is a small circular icon of a person with arms raised.


NEW MEXICO  TRUE

Back to New Mexico Home | Explore True Adventure 

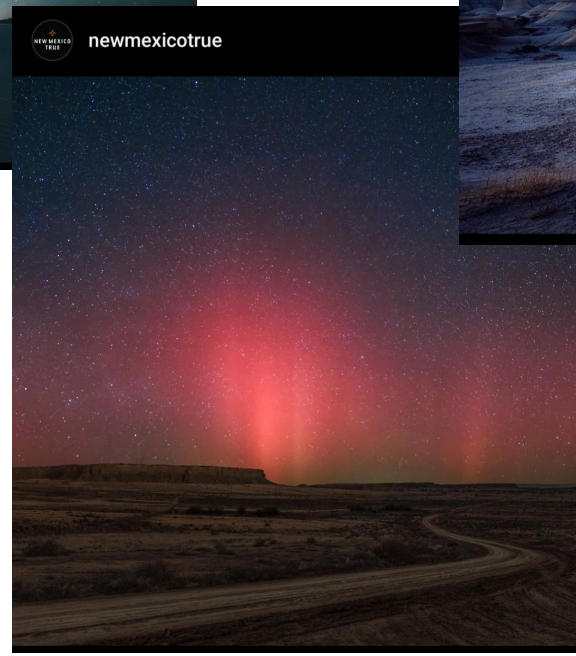
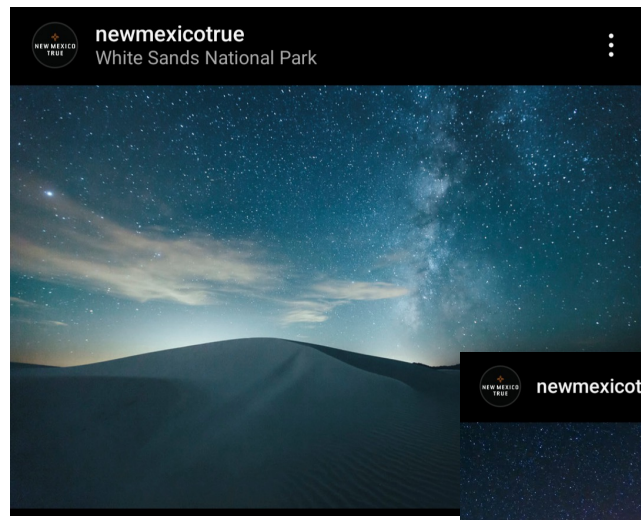
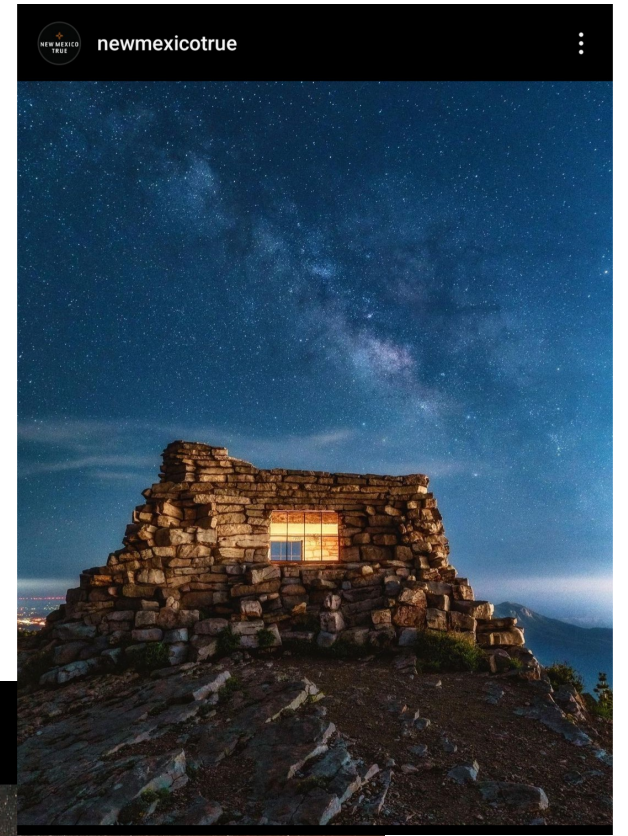
Dark Sky Events More Dark Sky Sites Resources & Maps 

 (0)  
MY TRIP

**New Mexico Dark Skies**  
New Mexico is the perfect place for stargazing



# Dark Skies on social media

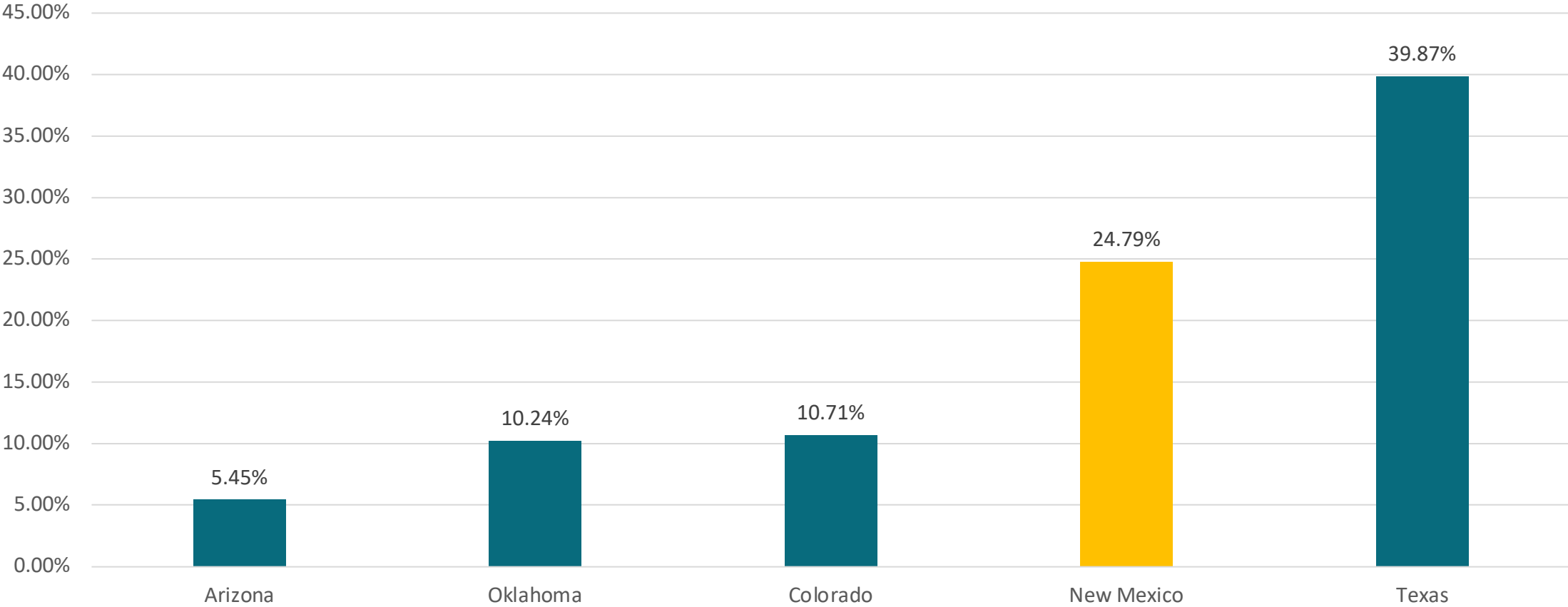




# Visitation to Dark Sky Parks in New Mexico



Top States of Origin



# 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



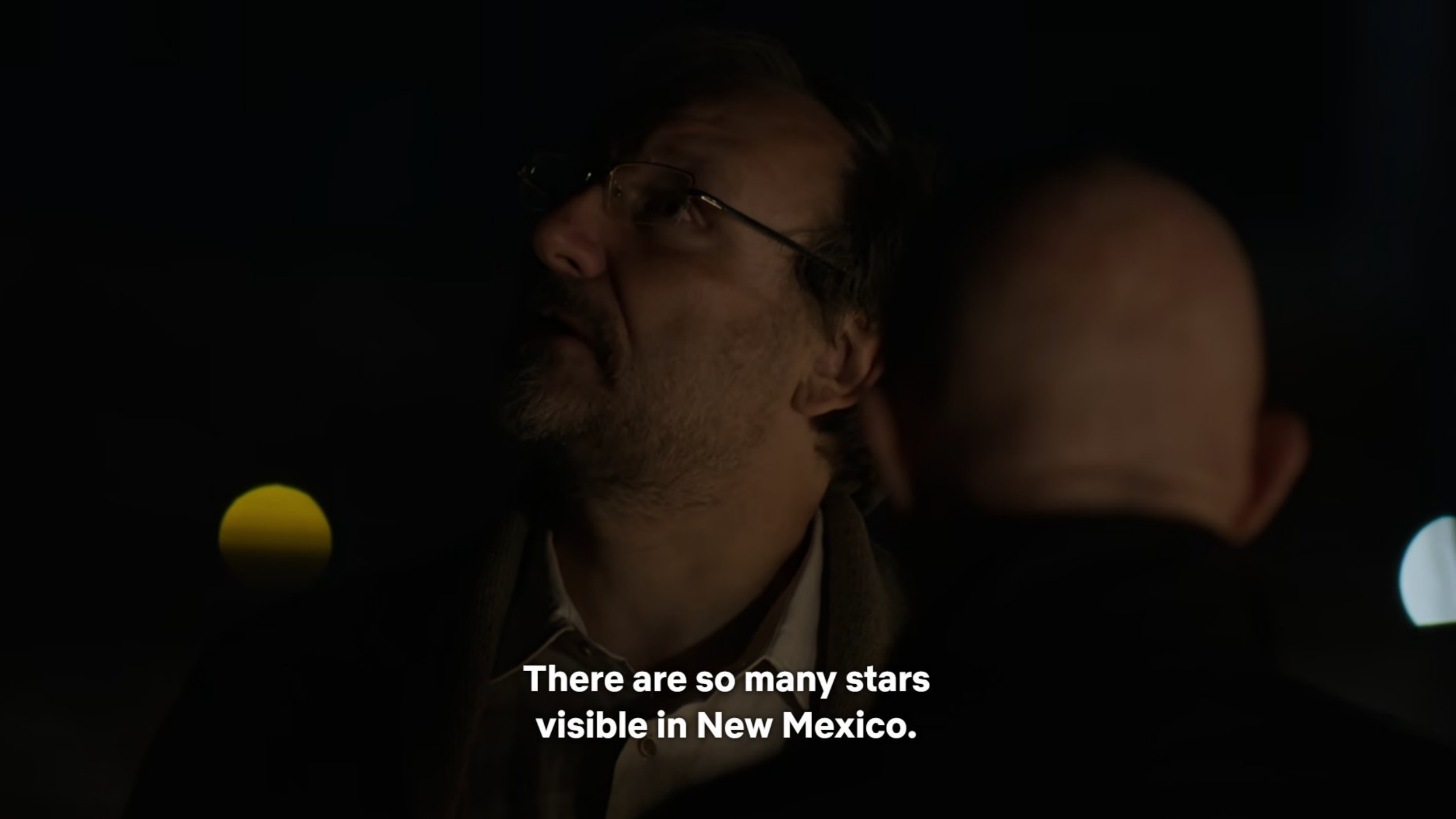
## Cooperative Marketing Grant Program

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](http://NewMexico.org)

A man with glasses and a beard is shown in profile, looking upwards. The scene is dark, with a few out-of-focus lights in the background, including a prominent yellow one on the left and a white one on the right. The overall mood is contemplative and serene.

**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

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# 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 ▾ ☰

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/darkskies](http://www.sfct.org/darkskies) 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**

---



# 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**

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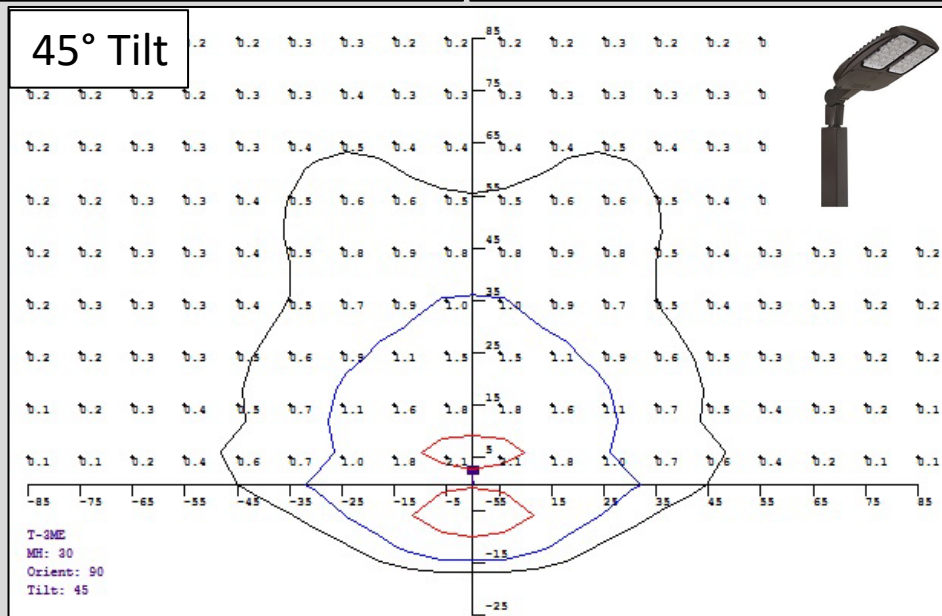
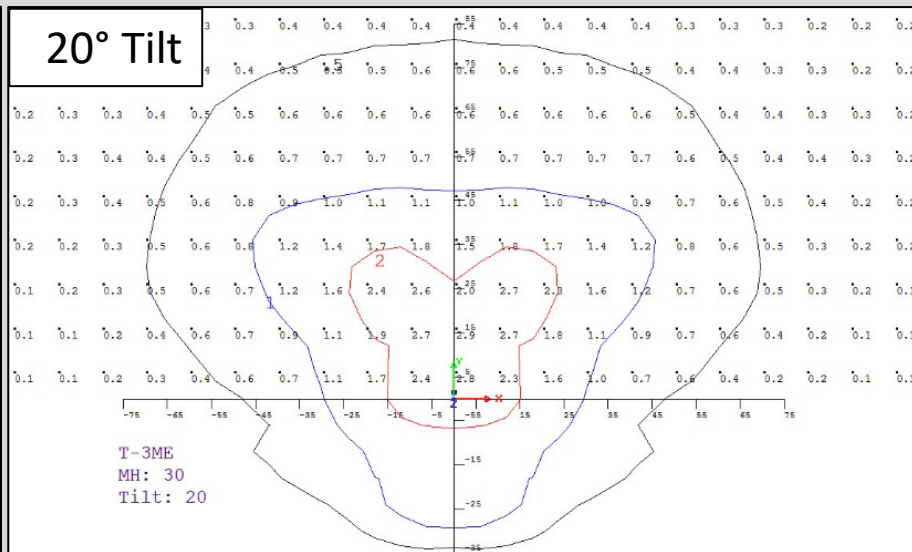
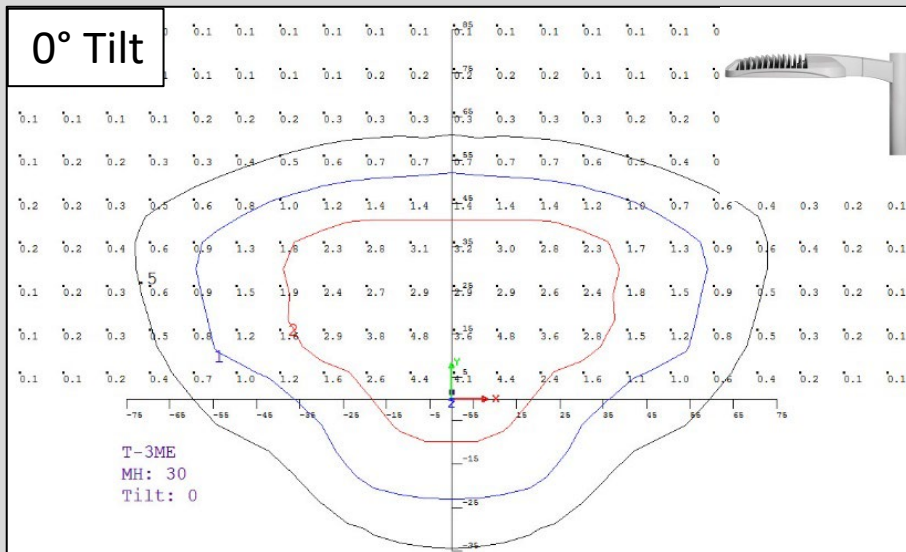






# And Furthermore...

## TILT CREATES LOW QUALITY LIGHT!

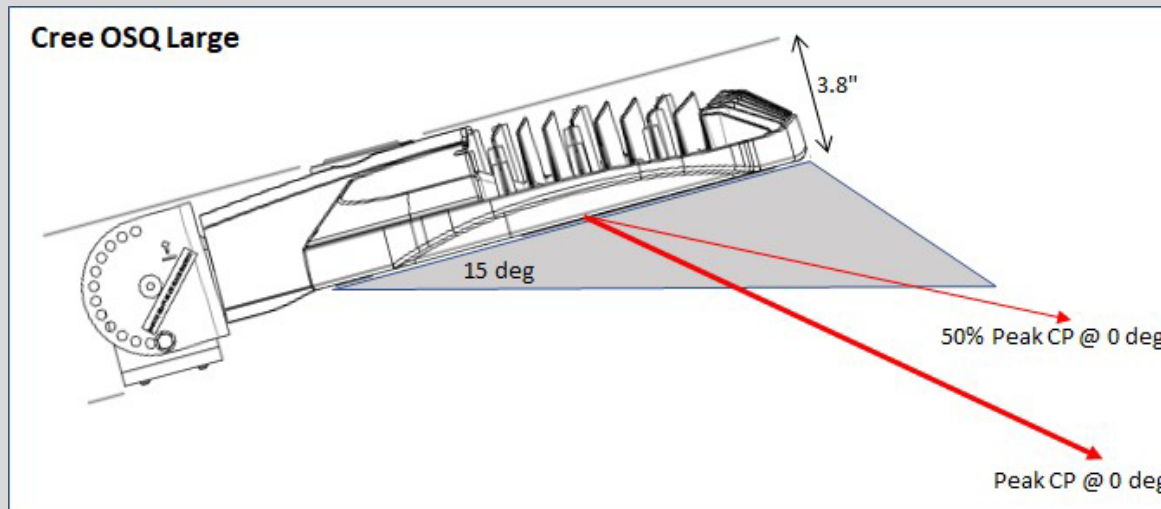






# Shield Development: Outer Fixtures

- 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.

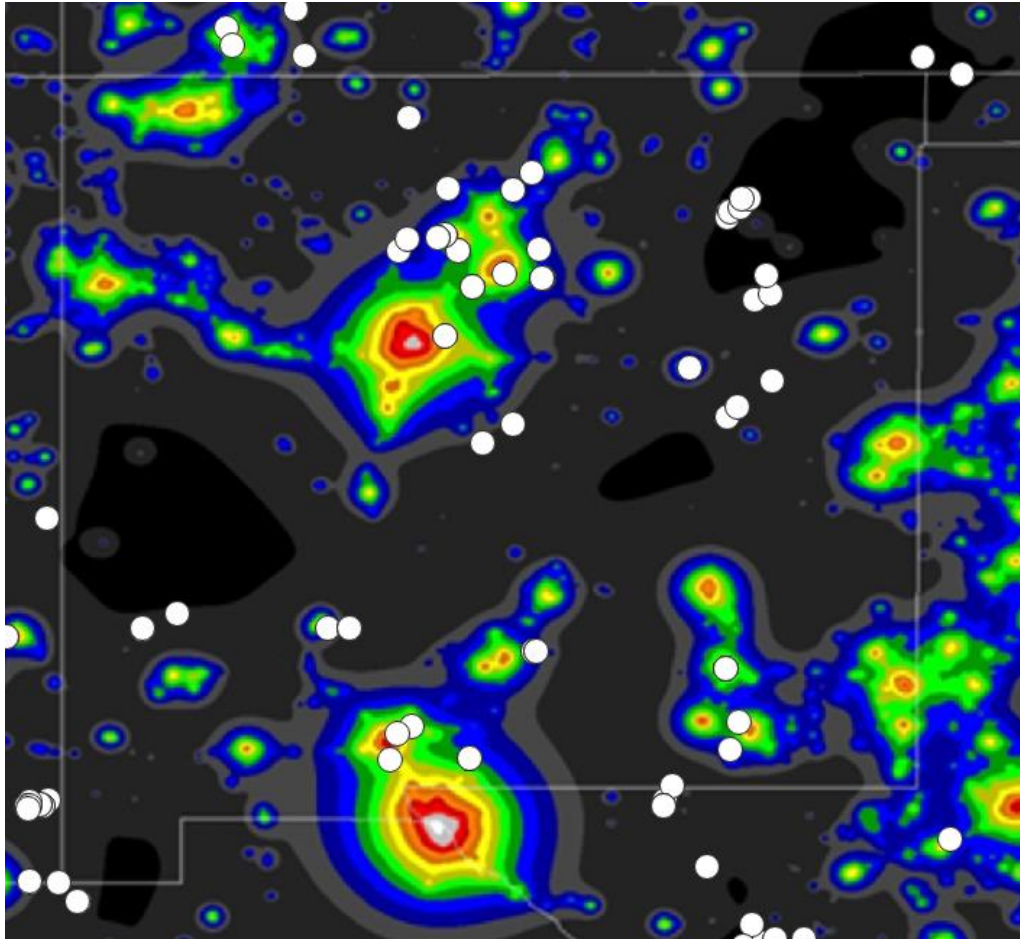
Loss of food biomass for other wildlife.

Reduced pollination rates.

Mismatches between mutualistic species.

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





Light Pollution Base Map: David Lorenz (darkskynm.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](mailto: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  
ILE  
EAD

HISTORIC  
**MAGDALENA**  
TRAILS END  
FOOD • GAS • LODGING

The sign is a large, colorful billboard with a western theme. It features a background of a sunset or sunrise over a green hill. Silhouettes of a cowboy on a horse, a person on foot, and a person on a horse are visible. The sign is supported by several wooden posts in a field of dry grass. The sky is clear and blue, and there are hills in the distance.







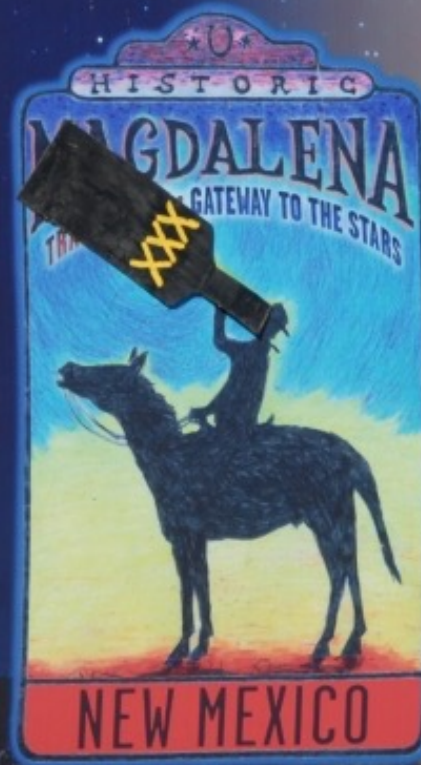




# WELCOME

"They don't  
make places  
like this anymore"

34°07'01.2"N 107°14'48.9"W



Gas • Cafe's  
Lodging • Camping  
Galleries • Hunting  
Saloon

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



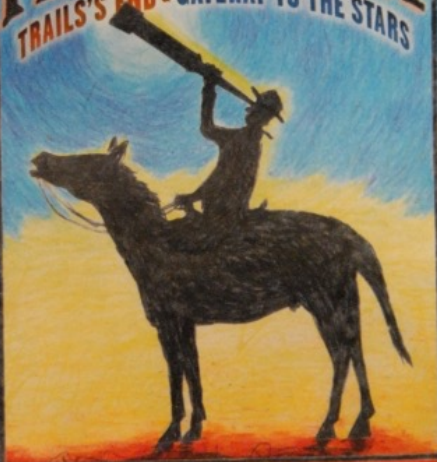


*Robert Le Sage*





HISTORIC  
**MAGDALENA**  
TRAILS' END & GATEWAY TO THE STARS



NEW MEXICO

TRAIL'S END  
GATEWAY  
TO THE STARS



**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)*



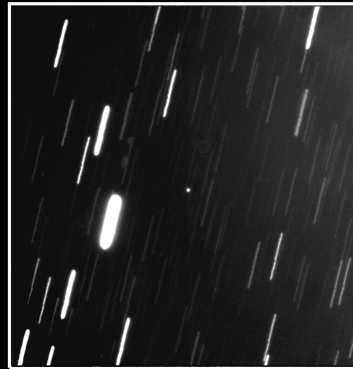


# NM Tech: Astronomy

## *Magdalena Ridge 2.4m Telescope: Operational since 2007*



Limiting Magnitude V~24.5



NASA PDO NEOs

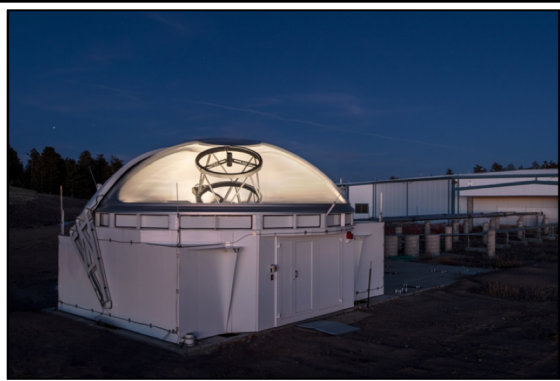


Space Domain Studies



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



# 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



USSF

# AFRL

# Laser-beacon adaptive optics

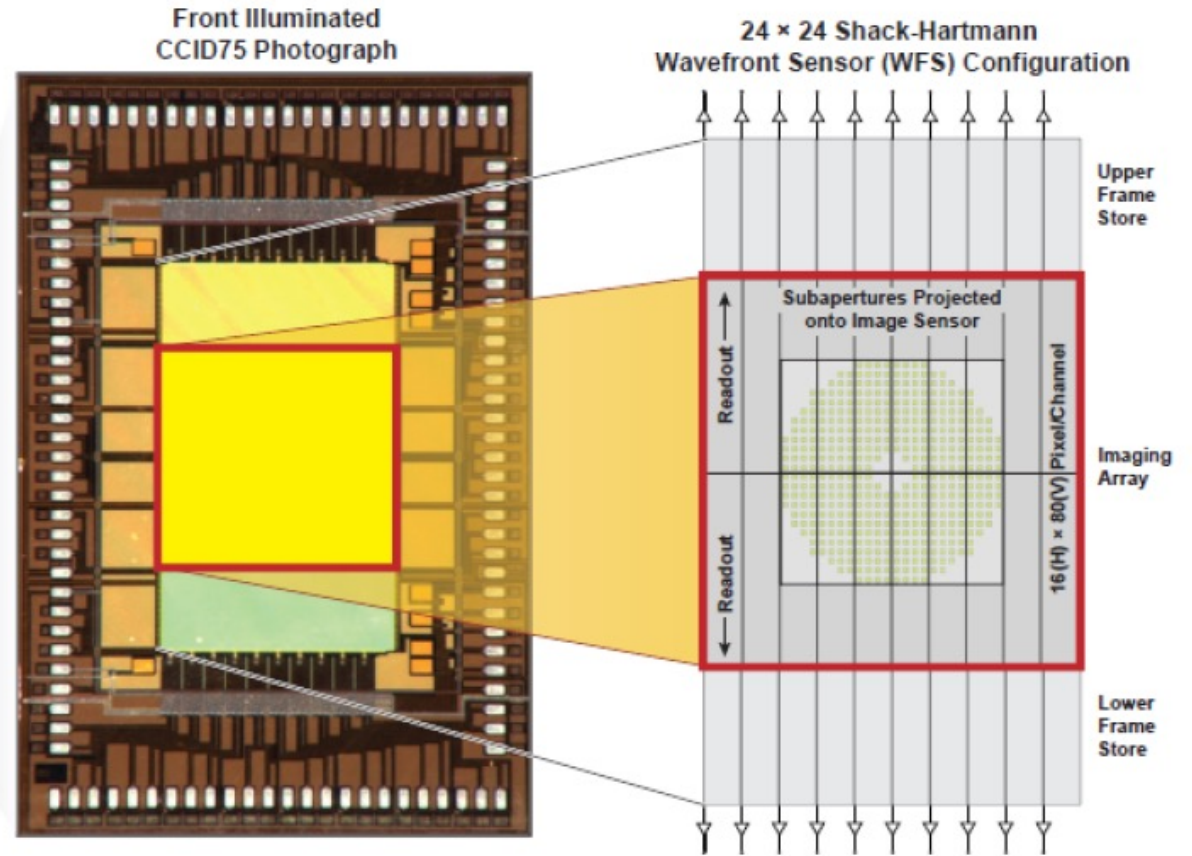
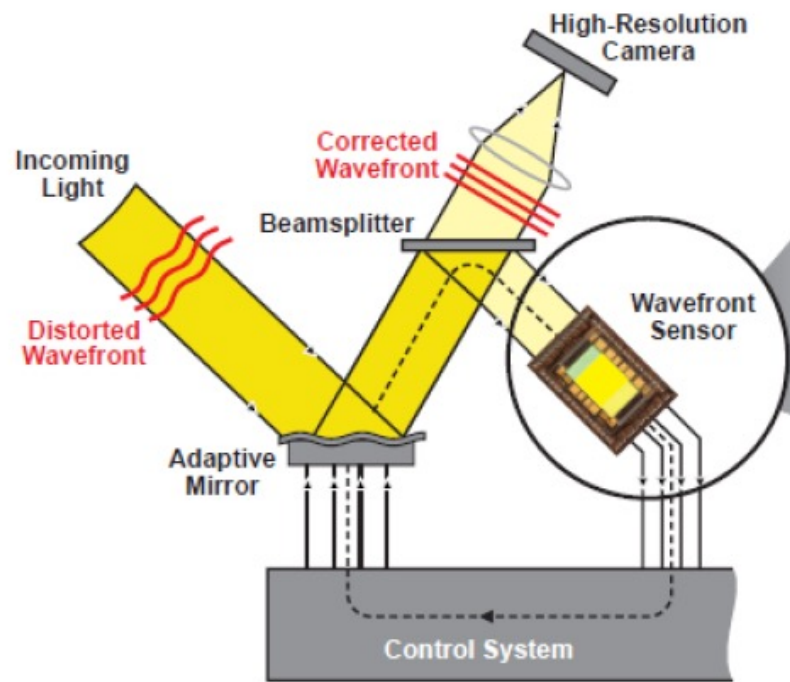
**Robert Johnson, PhD**

**Starfire Optical Range 2023-12-01**



# Adaptive optics and wavefront sensing

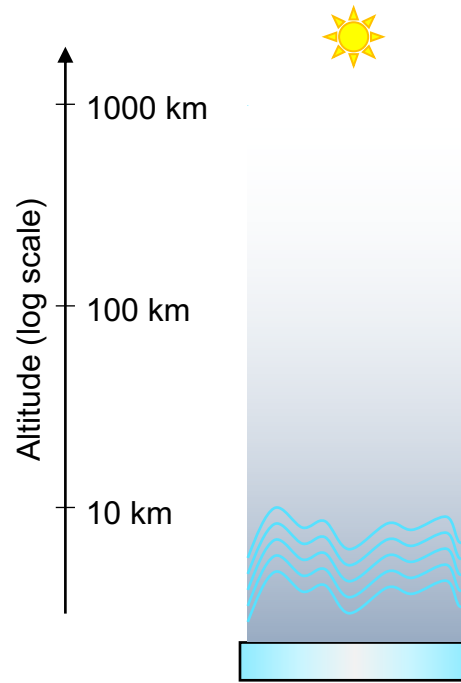
Adaptive optics work by measuring atmospheric turbulence induced distortion of a telescope's image and correcting these distortions using deformable optics. A critical component of this system is the wavefront sensor, which is used to measure the optical distortion. The speed and accuracy of this sensor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





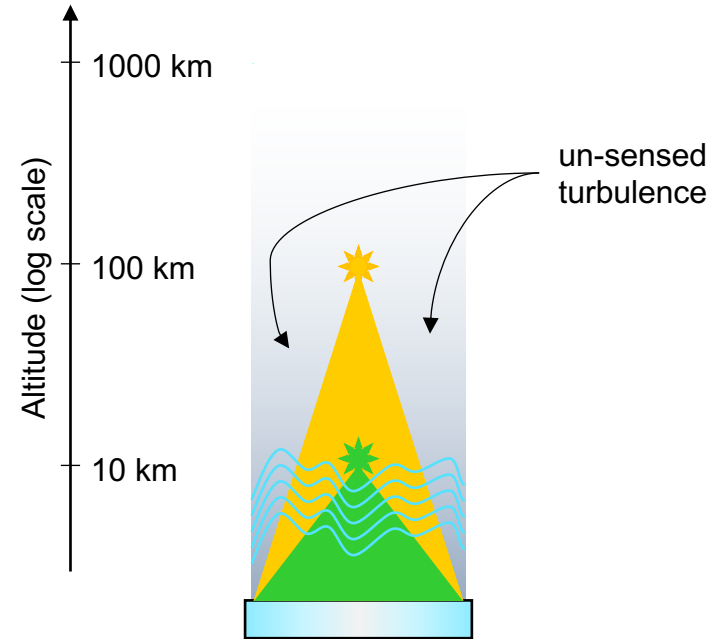
# Laser beacons

Natural guide star



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

Laser beacons



- 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



# 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