



Night Sky Protection and Restoration in U.S. National Parks

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A Landscape-Scale Partnership for Night Skies Conservation



Dan Duriscoe - NPS

NPS Night Sky Program

So...you want to start a Dark Sky Cooperative?

- Call to Action #27 – Starry Starry Night
- NPS is the leader
- America's first Dark Sky Cooperative

A voluntary effort to link communities, tribes, businesses, state agencies, federal agencies, and citizens...

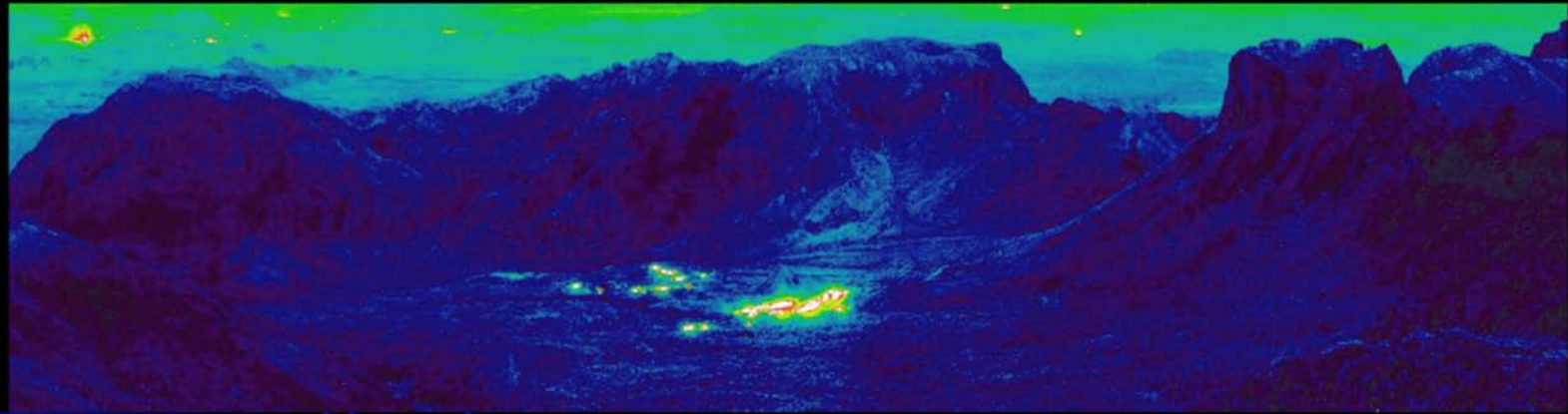
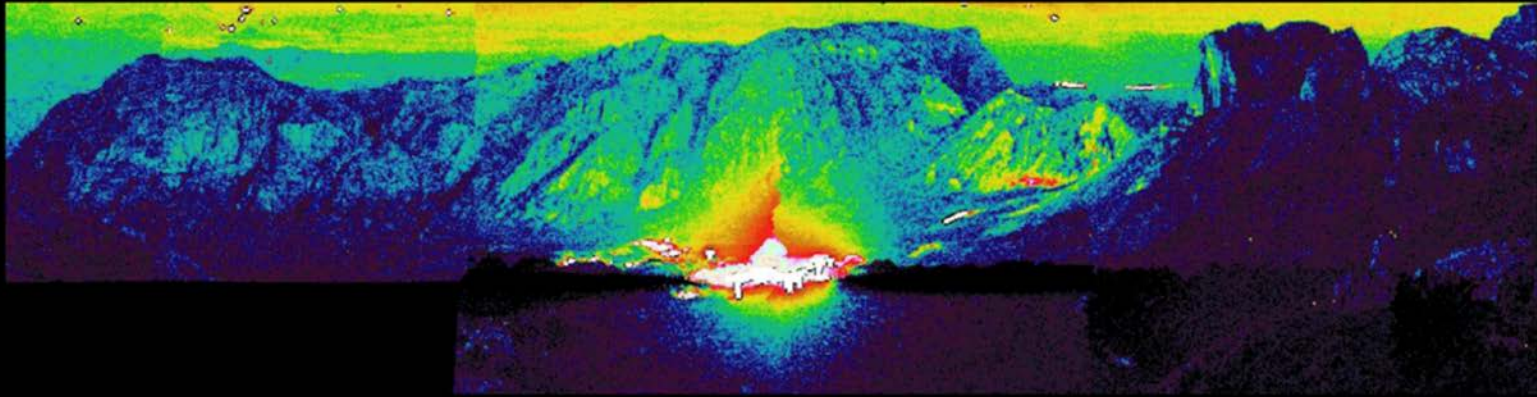


*...in a collaborative effort to celebrate
the view of the cosmos,...*



Chad Moore- NPS

...minimize the impact of outdoor lighting,...



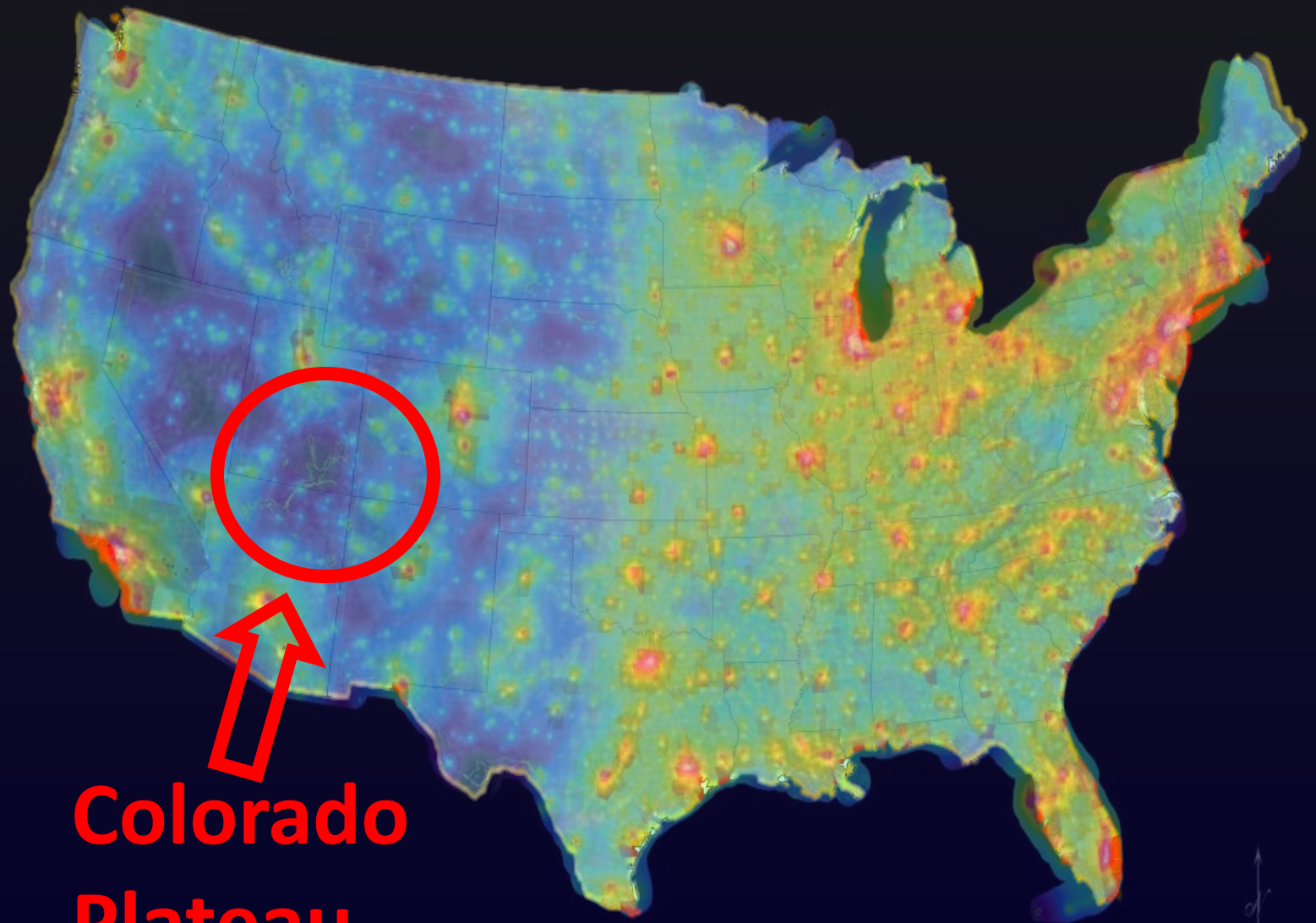
...and ultimately restore natural darkness to the area.





COLORADO PLATEAU
DARK SKY COOPERATIVE

Why the
Colorado
Plateau?

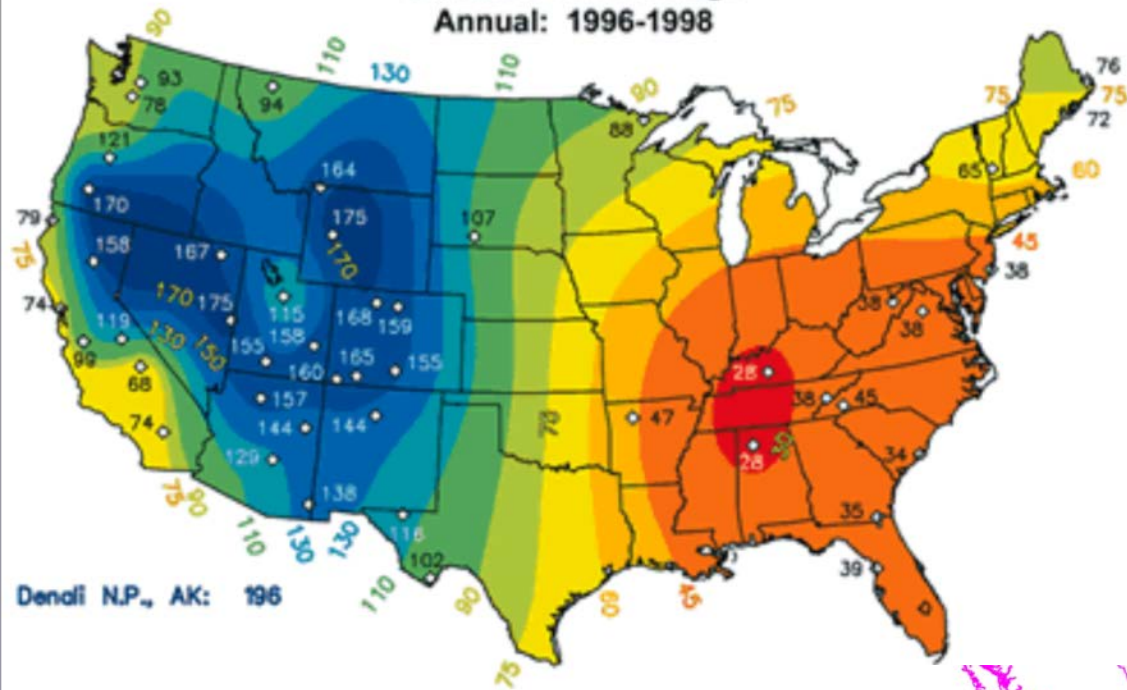


**Colorado
Plateau**

NPS Natural Sounds and Night Skies Division

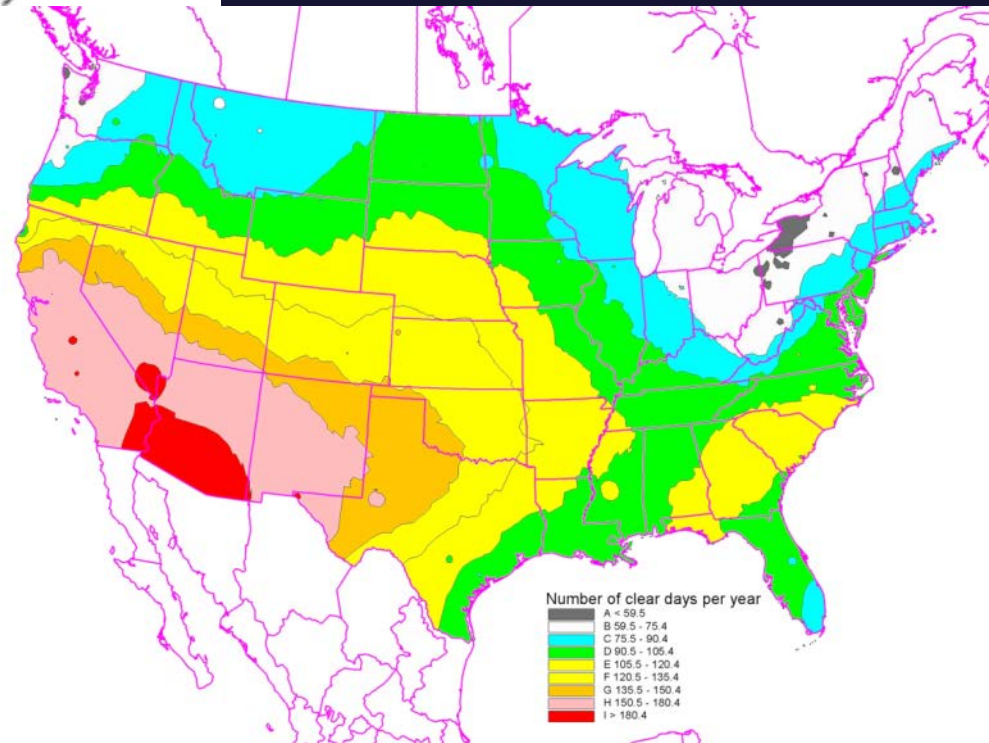
0 245 490 980 Kilometers

Standard Visual Range
Annual: 1996-1998



- High Elevation
- Low Precipitation
- # of clear days
- Clear, unpolluted air

- Low population density
- Dramatic landscape
- Worldwide visibility
- Large amount of public land

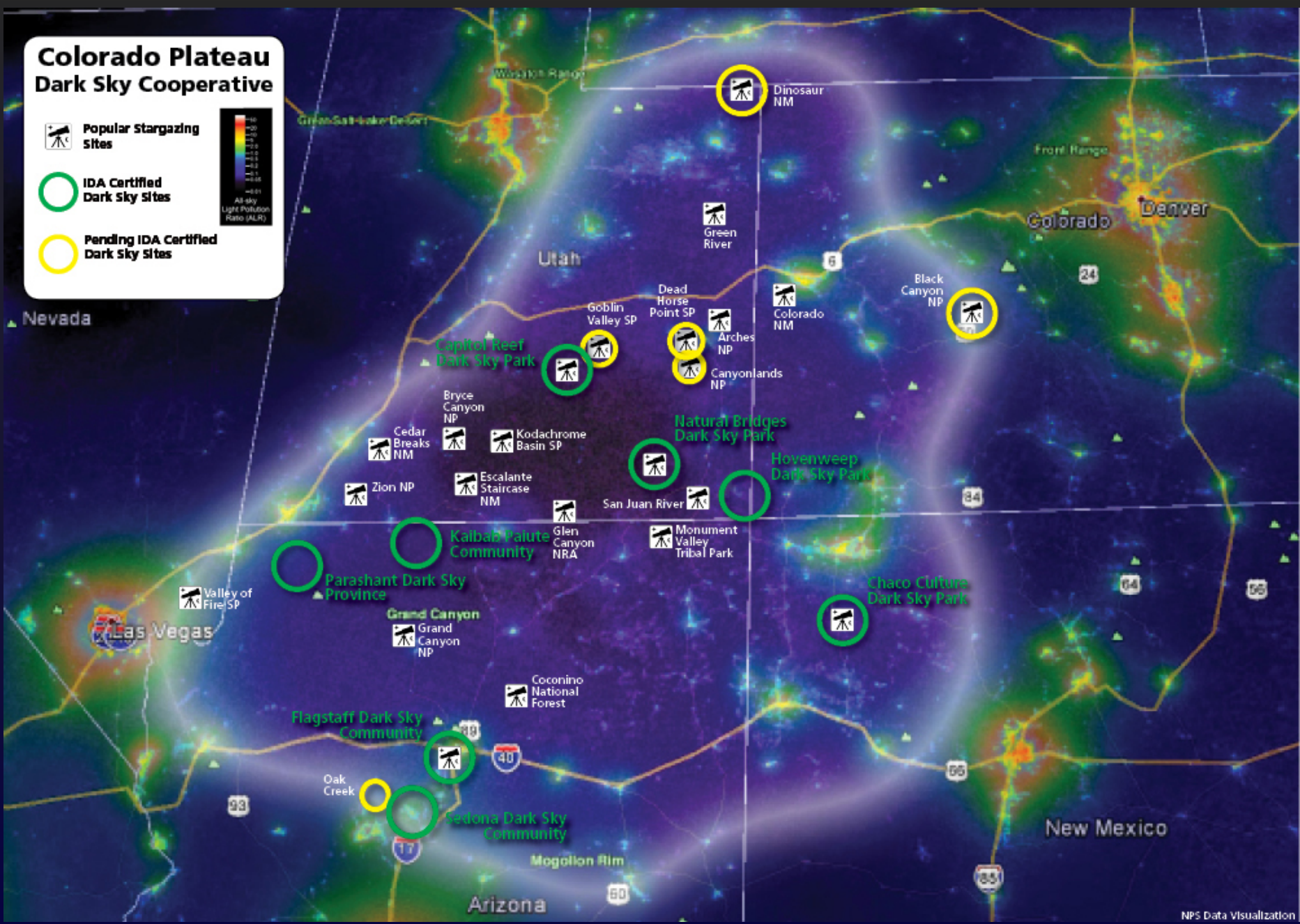
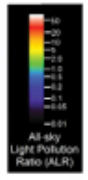


Colorado Plateau Dark Sky Cooperative

 Popular Stargazing Sites

 IDA Certified Dark Sky Sites

 Pending IDA Certified Dark Sky Sites



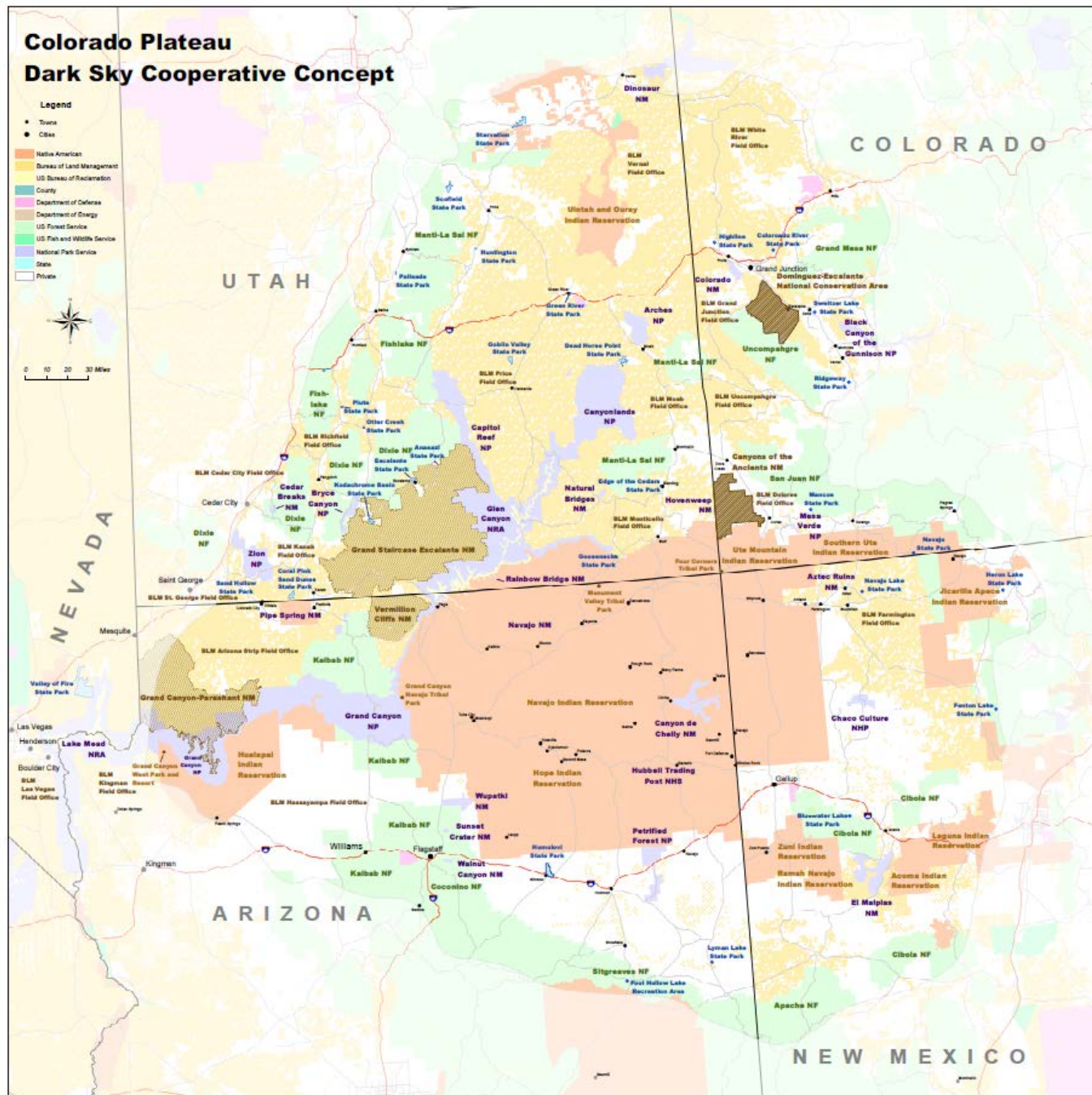
Colorado Plateau Dark Sky Cooperative Concept

Legend

- Towns
- CBAs
- Native American
- Bureau of Land Management
- US Bureau of Reclamation
- County
- Department of Defense
- Department of Energy
- US Forest Service
- US Fish and Wildlife Service
- National Park Service
- State
- Private



0 10 20 30 Miles



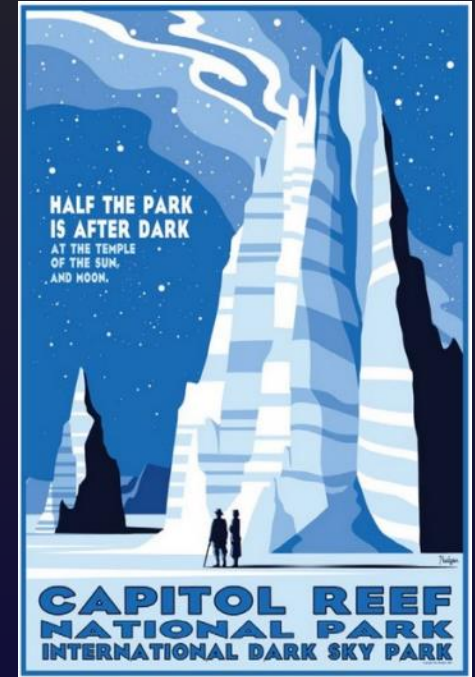
Clear Air and Magnificent Skies

- Search “Clear Air and Magnificent Skies (Utah)”

AND

- “Grand Canyon In Depth Night Sky”

International Dark Sky Parks / Places



Importance of Interpretation and Events



Jacob W. Frank - NPS

Education



Examples of night sky-related park contacts (2014):

Bryce Canyon – ~30,000

Parashant – 656

Black Canyon – 6,356

Canyonlands – 761

Capitol Reef – 3,766



[Bryce Astro Festival Timelapse](#)



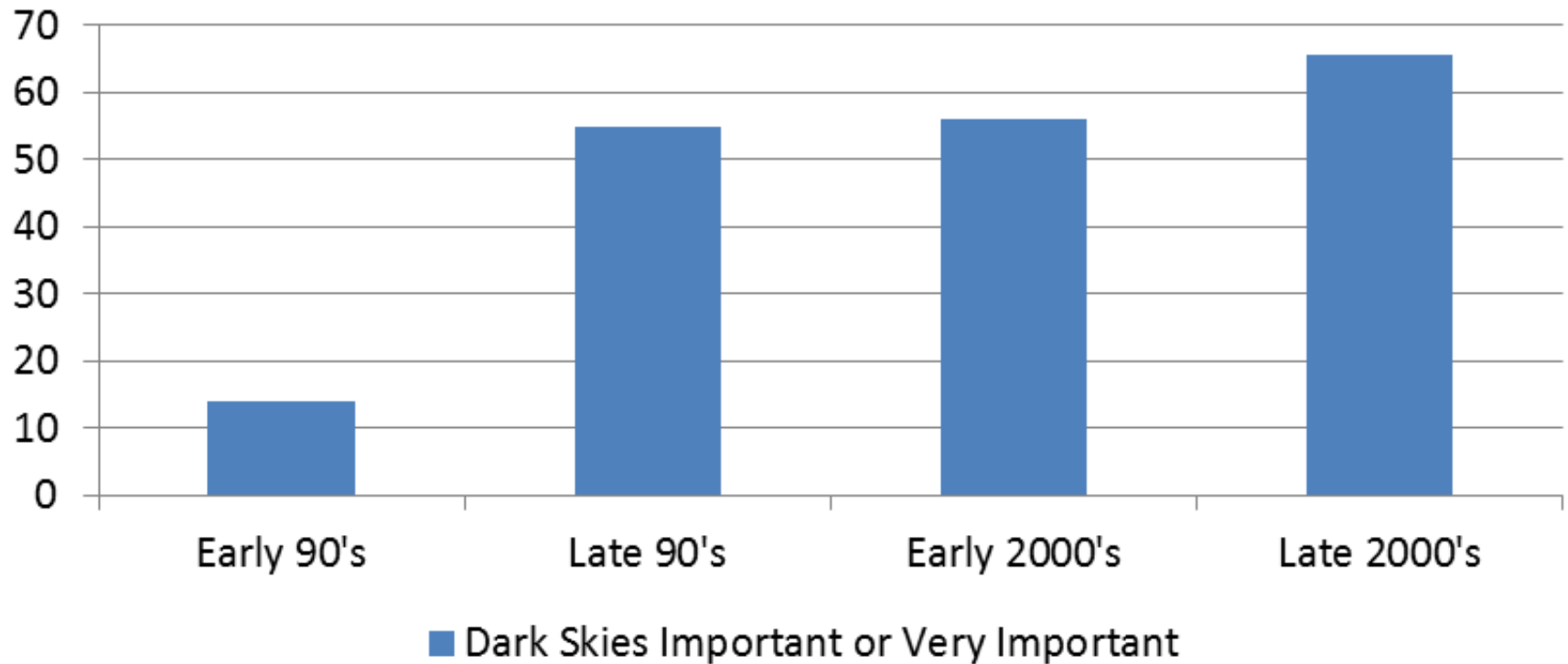
Astrotourism and Economic Benefits

- Bryce Canyon (2012) – Astronomy related attendance accounted for over 50,000 visits and \$2 million contributed to local economies
- Tourism office campaigns have increased some park visitation by up to 30% (Mighty Five- Zion)



Importance to NPS visitors

Dark Skies Important or Very Important



(Mitchell & Gallaway, 2015)

Estimating Potential Economic Value

- Spending per party increase from \$90 to \$270-390 (day vs. overnight)
- Change represents an additional \$1.68 billion value added to Colorado Plateau economies over 10 years
- Increase the **# of** visitors during the off-peak seasons and provide a longer more sustained period of tourism activity

Civic engagement and Partnerships

- Flagstaff is the world's first International Dark Sky City – has set standards and examples for comprehensive night sky-friendly lighting
- Sedona – recent IDSC designation
- Working with Moab, Monticello, Springdale, et al.



Work with guides and outfitters



Tyler Nordgren

Energy development



What can NPS parks do?

- Develop Lightscape Management plans for parks
- Inventory lights and plan for retrofits
- Work with NSNSD to collect night sky quality data
- Collaborate with interpreters to develop night sky resource educational materials
- Engage with gateway communities and local businesses
- Pursue Intl Dark Sky Park or similar designation

Success Stories

- Created night skies curriculum and training for Colorado Plateau outdoor guides and outfitters, reaching an estimated 40,000-50,000 trip participants each year.

Get to Know Your Night Sky

What can you see on a starry night? Many of us seldom experience a night sky like the one above the Colorado Plateau. Use this key to sharpen your observation skills and rate your night sky. The 9 steps of the Borlita Dark Sky Scale are presented along with intriguing tips and features of the starry sky.

1 **less than 300 stars visible**
Sky appears mostly completely washed out, and has a slightly glow. Dark adaptation of eyesight is not possible, the ground is brightly illuminated, and the Milky Way is invisible. Only the bright major constellations are identifiable. For instance, some of the "major" stars of Hercules, or the four stars of Delphinus are lost in the glare and twilight.

2 **about 500 stars visible**
Conversations are visible but may be missing key stars. Sky background has a uniform washed out glow with "light domes" reaching 60 degrees above the horizon. Stars such as the top of Sagittar or the "ice cream cone" of Orion are not visible, if clouds are present, they are brightly lit.

3 **about 1000 stars visible**
Brighter constellations are easily seen in full, yet sky background is a bright or yellow color. Milky Way may be just barely visible near the zenith (straight up). Clouds are much brighter than the background sky. Some dark adaptation is possible, revealing features in the ground.

4 **about 1500 stars visible**
The Milky Way is only visible straight overhead in the summer. Other features of the night sky are washed out by light domes. If clouds are present overhead, they are illuminated. Ground features may be seen with difficulty, and contrast with dark areas of artificial light.

5 **about 2000 stars visible**
The Milky Way is fairly present, but is then, broken by gaps, as it is visible from the horizon. One should tonight expect at least 1000 stars in the Milky Way are visible, and contrast with dark areas of the Milky Way. The dark rift in Cygnus is visible overhead in summer, and the Zodiacal light may be glimpsed, but is difficult to see amidst the light pollution. The Andromeda Galaxy is often visible.

6 **about 2500 stars visible**
The Milky Way is evident from horizon to horizon, but it lacks the detail. Clouds are dimly brighter than the background sky near the horizon, but appear darker at zenith. Light domes are brighter than the brightest parts of the Milky Way. The faint Zodiacal light from sunlight reflecting off solar system dust particles is visible in the west after sunset, or in the east before dawn. Deep sky objects such as the Hercules Globular Cluster M13 and Northern Coal Sack are visible.

7 **about 3500 stars visible**
The Milky Way appears complete and broad, extending perhaps 30 degrees wide and reaching the horizon. Some light pollution may be evident along the horizon. The Zodiacal Light is easily seen. Many star clusters and nebulae are visible with the naked eye and the light and/or dark sky clouds are striking, as is the dark rift in Cygnus. The bright planet Venus casts an obvious shadow.

8 **about 4500 stars visible**
Sky is almost completely natural, with no light domes extending above 5 degrees and none brighter than the Milky Way. Airglow is often visible on the sky near the horizon. The Zodiacal light extends across the entire sky as a band. The dark "smeared horse" is easily visible between Sagittarius and Scorpius. The Milky Way has the appearance of mist, with many faint stars and lines of bright stars.

9 **over 5000 stars visible**
Stargazers can spend a lifetime in search of Borlita Class 1 skies. The Milky Way is very broad, complete, vibrant, and takes almost three-dimensional. There is no evidence of artificial light, and the sky is free from pollution. Many deep sky objects such as the M42 galaxy or the hawk nebula are visible with the naked eye. The Zodiacal light is striking. A stargazer's nirvana.

10 **Did you know it can take 10 to 20 minutes to dark-adapt your eyes under moderately dark skies (Borlita Class 4-6)? Under the darkest skies, Borlita Class 1, it can take as long as 60 to 100 minutes to fully dark-adapt. Exposure to white or blue light quickly bleaches the chemical rhodopsin in the eye's retina, reducing sensitivity and requiring more time to gain back your night vision.**

11 **Why is Borlita? The Borlita Dark Sky Scale is a qualitative index developed by comet hunting astronomer John Borlita, and published in Sky & Telescope Magazine in 2001. (www.skyandtelescope.com)**

12 **Under dark skies you can often see more by using the "averted vision" technique. Because the eye's rod cells (that operate under low light) are found away from the center of focus, by looking sideways just a few degrees from objects will pop into view. Your eye is almost blind in the center of your vision at night!**

13 **Under full moonlight you can often detect some color in the landscape, indicating that the eye's cone cells have enough light to be active.**

14 **Use a red flashlight for greenway your night vision. This also reduces moon attraction.**

15 **Even a crescent moon can wash out the delicate features of the night sky. The best stargazing is during the "new" moon.**

Sometimes You Need Less Light to See

When we have difficulty seeing at night, we instinctively derive more light. But more light doesn't necessarily mean better visibility, where else is this more true than in our remote public lands, where the scattered light from distant overpasses and porchlights washes out the delicate features of a starry sky.

Society needs light at night to be productive and safe. However, our use of outdoor lighting has increased exponentially, and much of that light is aimed into the night creating sky glow, what some people refer to as "night pollution." The result has been an erosion of the beauty of the night. Many people, from seed researchers to coastal managers and campers, find value in experiencing a natural night sky. For nocturnal species, having a dark night environment can be a matter of survival. The increase in glare and sky glow has been one of the most obvious environmental changes across generations.

A clear and starry sky provides us a view into the cosmos. This perspective of looking beyond our planet is a deeply human experience and has changed the course of human history. It is difficult to imagine a more compelling view, and that fact starlight has inspired countless works of art, literature, and science. The night sky is bound to many religious themes and has provided us our first compass, our first clock, and our first calendar.

Across places such as the Colorado Plateau, people are traveling in order to once again experience a starry night sky. In many parks and public lands, stargazing has become incredibly popular. Astronomy festivals and weekly ranger programs provide outstanding opportunities to connect with the cosmos, while the constellations as our parents did with us, and remind ourselves how inspirational a natural night sky can be.

Did you know that a single candle 1 mile away is about as bright as the stars in the Big Dipper?

Did you know that stargazing benefits are becoming popular across the country, and provide immense benefit to surrounding communities. Photo by Ben Bergman.

Left: Thousands of people travel to Bryce Canyon for the Bryce Canyon Astronomy Festival, held annually in early September.

Right: The Westwater National Monument, located in southern Utah, is a National Monument. Photo: www.nps.gov

Our Window to the Cosmos

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Right: The Westwater National Monument, located in southern Utah, is a National Monument. Photo: www.nps.gov

Simple Solutions for Better Outdoor Lighting

Keeping the stars bright can be achieved through some surprisingly simple steps. Homeowners, businesses, and cities can each participate in making outdoor lighting more sustainable. Such lighting not only keeps the night sky beautiful and protects nocturnal wildlife, but is also more energy efficient and can actually improve visibility at night.

- Use timers or motion sensors to activate lights only when they are needed.
- Direct light downward by using fully shielded light fixtures.
- Use the right amount of light; more light is not always better.
- Use amber or "warm-white" light, avoid "cool-white" or blue light.

Above: The shielded eyes in a national park shows light domes and less light out of the sky when it is not needed for the view of the stars and Milky Way.

Vision for a Dark Sky Cooperative

America's first Dark Sky Cooperative will perpetuate starry night skies through voluntary actions across the Colorado Plateau. This innovative concept will link communities, tribes, businesses, state agencies, federal agencies, and citizens in a collaborative effort to celebrate the view of the cosmos, minimize the adverse impacts of outdoor lighting, and retain natural starry skies for future generations.

Protecting starry skies will also enhance tourism, commerce, protect cultural and tribal connections with the night sky, retain the pioneer heritage and charm of small towns, reduce carbon emissions, and save money.

Photo: Colorado Plateau Dark Sky Cooperative

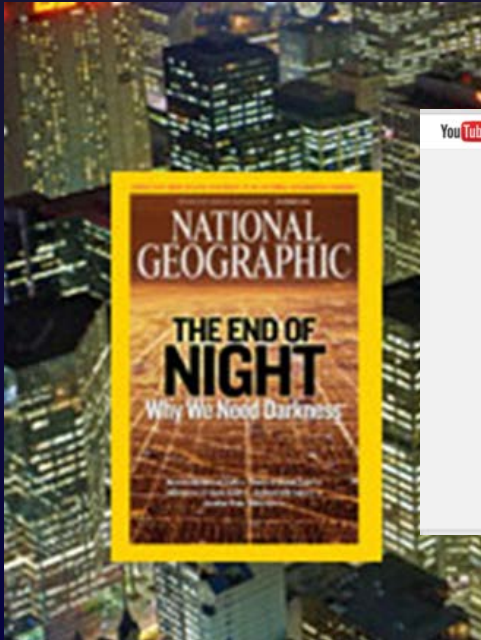
Success Stories

- 2014 – Partnered with Lowell Observatory and The Keystone Center to host the first Dark Skies and Emerging Technologies conference



Success Stories

- Since 2013, 138 new media articles and videos featuring Colorado Plateau dark skies and the Cooperative



More Success Stories

- 4 new International Dark Sky Parks since 2013 (PARA, CHCU, HOVE, CARE)
- 3 new International Dark Sky Communities
- 9 National Parks, 3 State Parks, and 3 communities pending



DARK SKIES

THEY'RE COMING



Thanks

- IMR Natural Resources Division
- NPS Night Skies Team (Bob Meadows, Jeremy White, Frank Turina, Dan Duriscoe, Chad Moore, et al.)
- Jacob Frank, Tyler Nordgren
- International Dark Sky Association
- Dark Sky Cooperative partners

Questions? Ideas?



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- NPS Night Skies Team

www.nature.nps.gov/night/

- International Dark Sky Association

www.darksky.org

Colorado Plateau Dark Sky Cooperative is on Facebook