

How To Conduct A Sky Quality Survey



Two hikers taking SQM measurements of the night sky on a trail in Saguaro National Park, Arizona. Photo by Jeremy White, National Park Service.

A thorough sky quality survey is essential to a successful application to the International Dark Sky Places Program.

There are a variety of ways to approach making a survey. These include:

1. Sky Quality Meter Survey
2. Bortle Scale Interpretation
3. Photographic Evidence

SKY QUALITY METER SURVEY



The Uniuhedron Sky Quality Meter (SQM) is the most widely used device for taking scientific-quality measurements of sky brightness. This small, battery-powered device is [available directly from the manufacturer](#) for US\$119.99 plus shipping and handling. The SQM is easy to use: simply hold the device above your head, pointing the photometer at zenith, and click the button. The screen will then display the sky brightness at that point in ‘astronomer’ units (magnitudes per square arcsecond). This unit is somewhat counterintuitive in that the higher the number, the darker the sky is. Take at least six measurements per location per visit, discarding the first measurement. Report all of the measurements.

Never take a measurement directly underneath a light source or anything that might block the clear sky. Always take measurements with clear open sky, cloudless, to prevent any sky glow measurements that will deter the accuracy of the device. Also, always take measurements on clear nights when the Moon is below the horizon. Measurements taken while the Moon is visible will not accurately reflect the natural darkness of your location.

Similarly, keep in mind the impact of twilight on your measurements. Only take readings under conditions of ‘[astronomical darkness](#)’, meaning that the Sun is at least 18° below the local horizon. Good sources of information for times of the end and beginning of astronomical twilight at your location on any given night can be found [here](#) and [here](#). (Note that for these calculators you may need to know your latitude, longitude, and local timezone offset from GMT.)

Using this device a “grid” of the locations may be made. It is essential to include areas that will be the darkest and the brightest to achieve a comprehensive survey of the location. The chart below is useful for visualizing how to plan the number and location of a set of measurements. Include measurements of the borders, active areas, and presumed darkest areas of the park. This data can then be organized into a map showing approximate location of measurements and a table. An example table is also shown below.

SQM Average	Location	Reserve Section (for Reserves only)	Notes
21.0	Border	Buffer Zone	
20.5	Active Area	Critical Buffer	Brightest Area
21.5	Darkest	Core Zone	Darkest Area

BORTLE SCALE INTERPRETATION

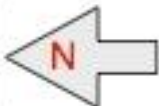
The Bortle Scale works to estimate sky brightness and interpret how light pollution is affecting your view of night sky phenomenon. The easiest way to interpret the Bortle Scale is an easy flow chart. Follow the questions to reveal what Bortle Class your skies fall under. This may need to be done at different locations in the location if sky brightness varies, for instance, you may have a Bortle Class between 3 and 4. The lower the number is, the better sky quality.

This method is less quantitative than the Sky Quality Measurement. An application using only this method to document Sky Quality is not as strong as an application using the SQM method or using two or more methods.

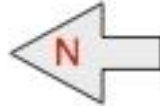
Steve Owens, International Dark Sky Places Committee member, is credited with the flow chart below. Learn more about it on his [Dark Sky Diary](#).

Have little to no experience stargazing? No problem. Visit [Sky and Telescope](#)'s article "[How to Start Right in Astronomy](#)" to learn more about picking up amateur astronomy skills. Also see Sky & Telescope's easy guides "Getting Started in Astronomy" for the [northern](#) and [southern](#) hemispheres for star maps and other information on how to proceed.

We also recommend looking for advice and help from local amateur astronomers. Find local astronomy clubs near you hosted by [NASA's Night Sky Network](#) (USA only).



Can you barely see M31?



Can you see all seven of the main stars of Ursa Minor?



The Bortle Dark-Sky Scale

The Bortle Dark-Sky Scale is a nine-level numeric scale that measures the night sky's brightness at a particular location.

It quantifies the astronomical observability of celestial objects and the interference caused by light pollution and skyglow.

John E. Bortle created the scale and published it in the February 2001 edition of *Sky & Telescope* magazine to help amateur astronomers compare the darkness of observing sites.

The scale ranges from Class 1, the darkest skies available on Earth, through Class 9, inner-city skies.

The colors in each box roughly correspond to the *World Atlas of Artificial Night Sky Brightness* and are provided as a guide only.



Can you see the Milky Way overhead?



Can you see Zodiacal light on the very best nights in spring / autumn?



Can you barely see M33, with averted vision?



Can you see M4, M5, M15 or M22 distinctly?



Is M33 easily seen, and does the Milky Way show detailed structure?



Is M33 seen with direct vision? Do the Sagittarius and Scorpius regions of the Milky Way cast a shadow?



Astronomical Objects Mentioned


- M31, the Andromeda Galaxy
- M33, the Triangulum Galaxy
- M4, a globular cluster in Scorpius
- M5, a globular cluster in Serpens
- M15, a globular cluster in Pegasus
- M22, a globular cluster in Sagittarius

PHOTOGRAPHIC EVIDENCE

Like the Bortle Scale method this method is less quantitative than the Sky Quality Measurement. An application using only this method to document Sky Quality is not as strong as an application using the SQM method or using two or more methods.

However, it can be very useful to support the Bortle Scale method and document specific nighttime phenomenon. For example, imaging the Milky Way, the Zodiacal light, and the Gegenschein make for a much stronger use of the Bortle Scale.

When including images also include a breakdown of the camera details used to take it, i.e. exposure time, focal length, ISO, etc... See the example below.

	Photographer:	Ameé Hennig
	Location:	Cerro Pachón, near SOAR Telescope in Chile (GPS location if available)
	Phenomenon Shown:	Milky Way, Large Magellanic Cloud
	Camera:	NIKON D3000
	Exposure:	17.5 sec (1/0)
	Aperture:	f/3.5
	Focal Length:	18 mm
	ISO Speed:	1600
	Special Editing:	None

Also take context images of the horizon showing light domes from cities or other sources of light that impact the proposed Dark Sky Place.

This method, along with others, have proven successful. If you have additional questions, please contact the Dark Sky Places Program Manager.