

## Methodology - season 1

Surveying the night sky requires scientific measuring technique in order to produce accurate and useful results. Readings will most likely be taken by different surveyors on different nights over a wide area, so technique must be consistent to minimise variation in results.

### Equipment

Unihedron Sky Quality hand-held meter model LThe light meter chosen is the Unihedron Sky Quality hand-held meter. This is a small reasonably priced unit powered by a PP3 9v battery. It is purpose designed for the task and has good low-light sensitivity. It comes in a protective pouch.



There is also a similar unit with USB output which can be connected to a laptop. This can be vehicle mounted and readings taken quickly, and consequently has a number of advantages over the hand-held device. To date no fully automated system which records both location and brightness readings has been found.

### Conditions

The weather conditions are critical to outcome of a night sky survey. The requirements are :-

- Moonless night
- Cloudless night
- No twilight or pre-dawn glow from the sun

A moonless night isv a fairly obvious requirement, as the moon when up bathes the entire sky with its reflected sunlight.



Using the hand-held meterA sky clear of clouds is also an absolute requirement. When cloud is at a low altitude there is obvious possibility that some light from the ground will be reflected. When cloud is very high it will block or reduce star light also affecting readings. Any cloud in the sky will introduce some unpredictability into readings so causing metering errors.

It may be wondered how often the above 'perfect' conditions occur, especially in Britain. They do, but not too often! Surveyors must be resigned to setting out to take readings on apparently clear nights only to find on arrival at the chosen site that readings must be suspended as cloud has appeared. It can be very frustrating!

As the sun and the moon's position can be accurately known in advance, a chart should be made of suitable surveying hours, so that all surveyors work within identical conditions. This chart can be sourced from SkyMap Pro software.

### Locations

Choosing locations for night sky readings are best determined before setting out, even if the area to be surveyed is familiar. Locations should be about 2 miles apart, which means that area surveys have to be done by car. Suitable locations are lay-bys, field entrances, or flat open spaces, and not close to trees. The safety of the surveyor and car should be considered, so off road is best to avoid passing traffic. In the middle of the night this is not usually a problem but see the note on safety equipment below.

It's important to log the exact location of a reading so that repeat readings can be taken in subsequent years and compared. Determining where you are by looking at a map on a dark night in the middle of nowhere can be a challenge.

One method of determining locations in advance is to use an Ordnance Survey map and a computer running Google Earth. The latter can indicate if the location chosen is likely to be a suitable pull-off area, and if so the O/S grid reference can be noted down in advance. Additionally this location can be entered in a Satellite Navigation device to get you there. This takes some time to plan but it saves a huge amount of time at night and prevents getting lost!



### Readings

In use the Unihedron meter is reading very low light levels and there is some display reading variation with each sample. The meter is held facing vertically up, and the button pressed. The meter may take some seconds to return a result so the meter should be held in position. It clicks to indicate it's busy. The LED read out is clear but some additional light is needed to write each reading down. [See additional equipment]

At each location eight separate readings are taken and all results recorded. If it is noticed that one reading is markedly different then it is worthwhile taking an additional reading.

### Results

After returning to base, the meter readings and position data from every location should be entered into a spreadsheet. The eight readings are averaged. This is done by discarding the highest and lowest readings, and then averaging the remaining 6 readings. This produces a good result while minimising the on-site time required. The (Open Office Calc) spreadsheet formula for this is

$$=((SUM(A1:H1)-MAX(A1:H1)-MIN(A1:H1))/6)$$

where the (A1:H1) cell range contain the eight meter readings.

### Displaying results

See report.

### Additional equipment

- Satellite navigation device

Experience has shown that some low cost additional equipment can make a considerable difference to the ease and speed of operation. Suggestions are :-

- Printed sheet to record readings on. [see this example]
- Clipboard.
- Large rubber or elastic band to hold sheets flat - worthwhile in a light breeze.
- Luminous vest
- Pen on a string. It's easy to mislay pens at night, and difficult to find in cold conditions when well wrapped up. Shown above is a pen secured on expanding cord with clip that fitted the requirement perfectly.
- A hand-held torch is not ideal since it must be held. A headband torch is much better and most astronomers will already own something similar. The torch must be easy to switch on and off since it must be off when taking readings.
- Luminous vest for safety.
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