

COMMISSION 50

PROTECTION OF EXISTING AND POTENTIAL OBSERVATORY SITES

*PROTECTION DES SITES DES
OBSERVATOIRES ACTUELS ET
DES SITES POTENTIELS DES
OBSERVATOIRE FUTURS*

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COMMISSION 50 WORKING GROUP

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Controlling Light Pollution

TRIENNIAL REPORT 2006 - 2009

1. Introduction

The activities of the Commission have continued to focus on controlling unwanted light and radio emissions at observatory sites, monitoring of conditions at observatory sites, and education and outreach. Commission members have been active in securing new legislation in several locations to further the protection of observatory sites.

During 2007 there were two landmark conferences related to light pollution. In February, the *International Dark Sky Association* organized a multi-disciplinary conference on light pollution in Washington DC, USA. This conference highlighted the many other problems that light pollution causes, including effects on wildlife, human health, and energy waste. It is clear that the need for protection of the night sky from light pollution extends far beyond astronomy, and astronomers can and should forge alliances with other groups to better protect the night sky.

In April 2007, the *Starlight* conference in the Canary Islands led to a “Declaration in Defence of the Night Sky and the Right to Starlight.” The IAU was one of the participating organizations for this meeting. The meeting brought together many of the world’s astronomers who are working on light pollution issues. In cooperation with UNESCO, the meeting has led to a draft proposal for *Starlight Reserves* which is described below.

2. Controlling light pollution

Population growth continues in regions close to the major astronomy sites in Hawaii, Chile, Arizona, and the Canary Islands. This growth, and its associated lighting continues

to pose a threat to the observatory sites. Retrofits of existing lights are needed to maintain dark skies over these observatory sites as the nearby population grows.

Good progress has been made in the retrofit of outdoor light fixtures in the astronomy regions of Chile. In the Antofagasta region, approximately 70% of the fixtures have been replaced, in the Atacama region, approximately 65% of the fixtures have been replaced, and in the Coquimbo region, approximately 45% of the fixtures have been replaced. Money is available to complete the retrofit in the Antofagasta region, and further progress is expected in the Coquimbo region in the upcoming year.

Imaging from the *International Space Station* showed that the airports on the island of Hawaii are the major source of broad-spectrum light affecting Mauna Kea. State legislation was passed in 2007 that requires new lighting at the airports and harbors in Hawaii to conform to county lighting ordinances. A program to retrofit airport lights on the island of Hawaii is now underway. A new lighting ordinance for the island of Maui was passed in 2007 and will reduce light pollution over Haleakala observatory by requiring retrofitting of non-conforming light over the next 10 years.

Elizabeth Alvarez serves as Commission 50 representative to the *International Commission on Illumination* (*Commission Internationale d'Éclairage* – CIE). This is an important engineering group setting standards for lighting.

Many activities related to light pollution are planned for the 2009 *International Year of Astronomy* (IYA 2009). Connie Walker at NOAO has been leading these efforts, and *Dark Skies Awareness* has been selected as one of 11 cornerstone projects for IYA 2009. Planned activities include *Globe at Night*, astronomy nights in National Parks, educational programs about good lighting, a night sky photography contest, a (radio) quiet skies program, dark skies discovery sites, *Dark skies week* and *Earth hour* when people around the Earth are encouraged to turn off their lights for 1 hour. These programs will have tremendous educational and outreach value.

A feature documentary entitled *The City Dark* is presently being produced by Wicked Delicate Films. It is scheduled to be released in 2009. It will highlight efforts being made to protect major observatory sites, including Mauna Kea and Arizona.

Wide interaction and cooperation with the *International Dark Sky Association* (IDA) is continuing, and the help that IDA provides is gratefully acknowledged.

3. Monitoring light pollution

As populations around observatory sites grow, there is a growing need for monitoring light pollution levels at observatories. Duriscoe, Luginbuhl, and Moore (2007) have developed a CCD camera system to measure light pollution in US National Parks. Systems such as this will be used in the future to quantify sources of light pollution and to measure trends in light pollution levels at observatories.

Dan McKenna and the *International Dark Sky Association* have been developing night sky brightness monitors. These are expected to be deployed to many observatory sites during 2009. These monitors will also help to measure long-term trends at the observatory sites.

Handheld Sky Quality Meters have been developed, and are affordable (approximately US \$120). They deliver V-band sky brightness in magnitudes per square arcsecond. These have become invaluable tools for outreach and education.

A concept for a satellite that would observe light sources on the Earth has been developed by Elvidge *et al.* (2007). Such a satellite would allow astronomers to precisely

pinpoint and measure sources of light pollution near observatory sites, monitor changes, and greatly help efforts to control light pollution at observatories.

4. RFI protection

Interaction with the *International Telecommunication Union* (ITU) is primarily made via the Scientific Committee on *Frequency Allocations for Radio Astronomy and Space Science* (IUCAF). This committee is composed of representatives from USRI (*International Union of Radio Science*), IAU, and COSPAR. Wim van Driel served as Commission 50 liaison to IUCAF.

An ITU *World Radiocommunication Conference* (WRC) was held in 2007 in Geneva. The main goal of these conferences is definition of the world-wide framework for spectrum management, including criteria for protection of radio astronomy from unwanted emission. WRCs are held every three to four years, and the agenda items are adopted at the previous WRC.

Of greatest relevance to astronomers, was an agenda item on protection of the radio astronomy service and Earth exploration-satellite (passive) service from unwanted emission in adjacent bands. Of particular importance to IUCAF was the case of the 1610.6-1613.8 MHz band that contains important spectral lines of the OH molecule. It was decided that the protection of this band is ensured.

The preliminary agenda adopted for the WRC in 2011 includes use of the radio spectrum from 275 to 3000 GHz. Although no allocations will be made at the WRC meeting in 2011, the radio astronomy community must identify a list of bands of interest.

International engineers and scientists have been studying the concept of solar power satellites. These typically have large (10 km²) solar panels in geostationary orbit, and transmit the power they collect to Earth in the form of microwaves. These have potentially disastrous consequences for both optical astronomy and radio astronomy. These satellites are not imminent, and many technological problems would need to be solved. However, they are so damaging to astronomy that careful attention is needed. URSI, IUCAF, and Commission 50 are continuing to monitor developments.

The major radio telescopes under development are presently ALMA and SKA. Commission 50 will provide help in efforts to protect these telescopes from radio interference when needed.

5. Developments within the past triennium

The emergence of light emitting diodes (LEDs) as a form of outdoor lighting is a new threat to astronomical observatories. For lighting near observatory sites, low-pressure sodium (LPS) lamps are the preferred light source. This is because the light they emit is nearly monochromatic. It can, therefore, be filtered out in some cases (e.g., *B* or *g* filter imaging); there is already natural emission from the atmosphere in the sodium line, so it is a wavelength that is already partially compromised. LPS lamps are highly energy efficient compared to other forms of lighting, and this has helped astronomers to get LPS lighting adopted around observatory sites, such as the Island of Hawaii, and La Palma.

White LEDs are now approaching, or in some cases exceeding the light output of LPS lamps in terms of lumens per Watt. They may require less maintenance, offer better color rendition, and the LED light fixtures may become less expensive than the LPS fixtures. White LEDs are essentially blue LEDs that have a phosphor that converts some of the

blue light into redder light. They typically have an emission spike around 460 nm – a region of the sky that is very dark. Additionally, Rayleigh scattering of 460 nm blue light is 2.7 times stronger than for the yellow-orange 589 nm light of LPS lamps. The impact of LED lighting will be a topic for discussion within the Commission 50 Working Group for *Controlling Light Pollution*.

The Canary Islands *Starlight* conference was conducted in cooperation with UNESCO. A further meeting between IAU representatives and UNESCO was held in October 2007, and a draft proposal for *Starlight Reserves* is being widely circulated. The specific types of starlight reserves proposed include starlight heritage sites, starlight astronomy sites, starlight natural sites, starlight landscapes, rural and urban starlight oases, and mixed starlight sites. The most relevant to astronomers is the *Starlight Astronomy Site* designation. This designation would relate to exceptional observation sites for optical, infrared, and radio astronomy, and include potential future sites.

6. Closing remarks

The tragic accidental death of Hugo Schwarz was an enormous loss to Commission 50, and to the international effort to protect observatories from light pollution.

Our Commission continues to believe that more professional astronomers need to become involved in efforts to reduce light pollution and to reduce radio interference.

Richard J. Wainscoat
president of the Commission

References

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- Duriscoe, D. M., Luginbuhl, C. B., & Moore, C. A. 2007 *PASP*, 119, 192