

Starlight: a common heritage

Cipriano Marin

Starlight Initiative,
Instituto de Astrofísica de Canarias,
38205 La Laguna, Tenerife, Spain
email: c.marin@unesco-can.org

Abstract. The *Starlight Initiative* brings a new view of the night sky and of its value enhancement, claiming the access to starlight as a scientific, environmental, and cultural right of humankind. Night sky quality has been seriously damaged in the last years because of light and atmospheric pollution, and an international action in favour of intelligent outdoor lighting is urgently needed. After the promulgation of the Starlight Declaration, we are jointly working with UNESCO, the World Heritage Centre, the MaB Programme, and other international institutions in the development of *Starlight Reserves* as exemplary areas that would act as models for the recovery of the heritage associated to star observation. The possibility arises to design and launch new tourist products and destinations based on astronomy and starry sceneries.

Keywords. Starlight, dark skies, light pollution, world heritage, nightscapes, intelligent lighting

1. Introduction

The *Starlight Initiative* is an international campaign in defence of the values associated with the night sky and the general right to observe the stars. It is open to the participation of all scientific, cultural, environmental, and citizens' organizations and associations, as well as public institutions and to any public or private body willing to effectively cooperate in the conservation of clear skies and the dissemination of the knowledge related with their observation. The final aim of this initiative is to strengthen the importance of clear skies for humankind, emphasizing and introducing the value of this endangered heritage for science, education, culture, technological development, nature conservation, tourism and, obviously, as a quality-of-life factor.

The *Starlight Initiative* was officially launched during the International Conference *Starlight: a Common Heritage* held in April 2007 on the island of La Palma. This meeting, held under the auspices of UNESCO, was promoted by the IAC (Institute of Astrophysics of the Canary Islands) and the Spanish and Canary Islands' Governments. It relied on the collaboration of the main international organisations that were directly or indirectly involved in recovering the values associated to the nocturnal sky. It was decidedly supported by UN-WTO (World Tourism Organization), CMS (Convention on Migratory Species), Ramsar Convention, CBD (Convention on Biological Diversity), UNESCO-MaB Programme, World Heritage Centre, and IAU (International Astronomical Union). Besides them, more than 100 institutions from 42 countries joined the initiative.

The main agreement was definitively expressed through the approval of the *Starlight Declaration*, adopted on April 20th, 2007. Point one of the *Declaration in Defence of the Night Sky and the Right to Starlight*, stated that “an unpolluted night sky that allows the enjoyment and contemplation of the firmament should be considered an inalienable right of humankind equivalent to all other environmental, social, and cultural rights”. This view highlights the fact that a so-far unscathed right is now in serious danger and that

its degradation will lead to the irremediable loss or neglect of an extensive associated cultural, scientific, scenic and natural heritage. Previously, in 1994, the Universal Declaration of Human Rights for Future Generations, was imbued with a highly advanced sensitivity about this right when it was recognised that the “*persons belonging to future generations have the right to an uncontaminated and undamaged Earth, including pure skies; they are entitled to its enjoyment as the ground of human history of culture and social bonds that make each generation and individual a member of one human family*”.

2. Where Earth meets the universe

Within this context, and with the idea of recognizing and identifying the legacy associated with the starlit sky, the proposal to develop a *Starlight Reserve* concept as one of the additional recommendations to the *Starlight Declaration* emerges, having been developed in recent years with the support of the organizations that promoted the Declaration and the Starlight Scientific Committee, in cooperation with the World Heritage Centre through its Thematic Initiative, Astronomy and World Heritage. A *Starlight Reserve* is a site where a commitment to defend the night sky quality and the access to starlight has been established. Its main function will be to preserve the quality of the night sky and its associated values. The *Starlight Reserve* concept, inspired in the basics of the initiative itself, encompasses many dimensions, which are the countless windows of the Earth on to the starlit sky. It goes further than the mere protection of the astronomical quality of the sites, as it aims to recover and identify the existing values related to the night sky, including those related to landscape, nature, opportunities for science and, in general, with the associated tangible and intangible cultural heritage.

The power of the cultural dimension is irrefutable. The interest in astronomy, or simple contemplation of starry skies, has always had profound implications for philosophy, science, arts, culture and for the general conception of the universe in every community all over the world. Each place has its own view of starlight handed down through generations: legends, folk tales, sacred landscapes, objects, monuments and traditional festivals. However, we find ourselves in the face of an ensemble of manifestations that we can now consider as endangered. A large part of the present generation are the first in history that have grown up without any direct contact with the beauty of a starry sky, in an environment where these cultural references are falling into the oblivion. An essential element of our civilisation and culture is rapidly becoming lost, and this loss will affect all countries on Earth.

3. Windows to the universe

The scientific and technological dimension of a starry night is an essential part of the legacy of the sky. The ability of the planet’s astronomical sites and observatories to detect and interpret data from outside the world we live in should be considered untouchable. Dark skies are an essential condition to maintain these windows to knowledge of the universe.

However, unlike ancient monuments and technological tools related to astronomy, current areas devoted to astronomical observation do not enjoy appropriate recognition. Ground-based observatories are exceptional windows for the observation of the universe, and they have provided the vast majority of our knowledge of astronomy. However, present technical requirements restrict suitable areas to very specific and limited locations offering good conditions for the development of advanced astronomy, and of optical and infrared astronomy in particular. The best astronomical sites must be places located



Figure 1. From left to right: (a) GTC (Gran Telescopio CANARIAS), La Palma Biosphere Reserve, © Nik Szymanek; (b) Mauna Kea Observatory, Hawaii © Richard Wainscoat; (c) Cerro Tololo, Chile © Roger Smith (CTIO).

at high altitudes, with little turbulence, such as on the west coasts of continents or on oceanic islands. They must also be located at sites with less air pollution and low aerosol content. With the exception of a few exceptional cases, high mountain areas isolated from the temperature of the ocean and coastal mountains near to cold oceans with stable, subtropical anticyclone conditions are the best possibilities. We are talking about very few places on the planet where we find a unique combination of environmental and natural circumstances, well conserved spaces with very little alteration to natural starlight. These are a limited resource that needs to be recognised and protected.

Having reached this point, it is essential to remember that the World Heritage Convention refers to science in Articles 1 and 2. More specifically, in Article 2 it establishes that it shall be considered as natural heritage: “*natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty*”. For this reason, it is hardly surprising that in the process of developing the Thematic Study *Starlight Reserves and World Heritage* the few places that can offer these properties have been identified as relevant case studies, and a proposal for serial nomination of these very special spaces in places like Hawaii, Canaries and Northern Chile, is at present being prepared.

4. Clear skies, nature and nightscapes

Beyond the importance of the scientific and cultural legacy related to astronomy and starlight, there is a landscape dimension and the conservation of nature in relation with the beauty and the quality of the night sky. It is curious to see that when we talk about natural or cultural landscapes of natural beauty, there are very few references to nightscapes, and even less if we talk about landscapes that have been declared world heritage properties. However, the light of stars and other heavenly bodies has always enriched terrestrial nature’s display as well as human habitat, creating reference landscapes traditionally perceived by people as an integral part of their natural and cultural heritage. Nevertheless, the nocturnal dimension of skyscapes, in spite of their diversity and magnificence, are still the most hidden part of this kind of landscapes. The experiences of evaluating nightscapes as a promotion of the starlit scenery at Arches NP (USA), La Palma (Spain) or Easter Island (Chile), highlight the enormous potential of this new concept and the need to recover this dimension in the strategy of the starlight reserves.

We can make similar considerations about the nocturnal aspect of nature conservation. The experience accumulated in some dark sky parks like the Natural Heritage Programme of Torrance Barrens (Canada) or in emblematic places for nature conservation like Doñana (Spain) or Hortobágy (Hungary), forces us to seriously consider the



Figure 2. A chameleon (*Furcifer verrucosus*) at night. Cap Sainte-Marie (Madagascar).
© Giuseppe Orlando.

importance of dark skies for conserving nature and the exceptional values that certain spaces have with regard to the night.

The loss of quality of nocturnal skies, caused by the negative effects of atmospheric emissions and of the increased intrusion of artificial lights, has become a serious threat for many species, disturbing their habits and habitats, as well as the basic functions of ecosystems. Darkness and natural night light are indispensable for the healthy functioning of organisms and ecosystems. We usually forget that life lives 24 hours a day and that ecosystems adapted themselves to the natural rhythms of the Moon and stars during millions of years of evolution. As over half of the creatures living on this planet are nocturnal, any degradation in the quality of sky, by day or by night, is having a profound effect on their behaviour and on the equilibrium of the biosphere. In addition, many diurnal species adjust their vital cycle according to night duration.

Light pollution, in particular, has been shown to have a widespread, negative impact on many different species. Scientific evidence for this impact in migratory birds, hatchling sea turtles, and insects is striking, because of the large-scale mortality that has occurred as a result of artificial night lighting. Light pollution can confound animal navigation (many species use the horizon and stars for orientation), alter competitive interactions, mutualisms and reproduction behaviour, change the natural predator-prey relationship and even affect animal physiology. Amphibians are well-studied in this sense, as well as a number of nocturnal or crepuscular mammals such as bats, some primates, many rodents and marsupials, which all suffer from what is now called *biological photopollution*. Disturbing data on light pollution effects on flora and phytoplankton are also being obtained. This is because many plants time their development, growth and flowering behaviour by measuring the seasonally changing length of the night, which is impossible when there is light pollution.

Applying the *Starlight Reserve* concept, especially in the case of natural areas, would allow establishing new bases to safeguard Earth's biological diversity. The night sky quality dimension should be at least included in the management and conservation of protected areas and important habitats. Ramsar wetlands, natural areas declared World Heritage Sites, Biosphere Reserves, National Parks, marine sanctuaries, and other protected areas have to face up to a new responsibility: saving life at night. We should not forget that the increasing artificialisation of nocturnal light is causing negative effects also to the human species, with a demonstrated repercussion on people's health and behaviour.

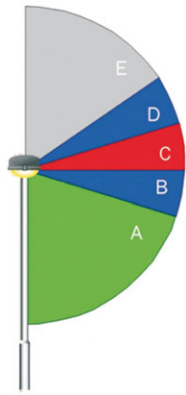
5. Intelligent lighting and starlight

The natural night sky light comes from starlight, zodiacal light (sunlight scattering from dust in our solar system), and airglow (atoms and molecules in the atmosphere that glow in the night after absorbing solar radiation) in roughly equal quantities. Even a small amount of artificial light interferes with this delicate balance, changes the colour of the sky, and overwhelms the starlight. Light pollution has become a worldwide problem as it is gradually diminishing the capacity to observe the stars. This new kind of waste originates cultural, environmental and even energy impacts, with unforeseeable consequences.

Light pollution can be defined as the introduction by humans, directly or indirectly, of artificial light into the environment. Avoidable light pollution refers to light flow emitted at night by artificial light sources which are inappropriate in intensity, direction and/or spectral range, unnecessary to carry out the function they are intended for, or when artificial lighting is used in particular sites, such as observatories, natural areas or sensitive landscapes. Among all causes having a negative effect on night sky quality, light pollution shows the highest immediate risks but, at the same time, it can be reduced through viable solutions. Irresponsible lighting includes over-illumination, which makes an excessive and unnecessary use of artificial light, as well as poorly designed luminaires which cause glare or sky glow. The *Starlight Saving Time* takes into account the time when artificial lighting is strictly necessary. Dark Time saves energy, saves our heritage, and promotes life quality, as well as cultural and scientific investigation. The common factor of these phenomena is the loss of the capacity to observe the stars, together with unnecessary impacts on people life quality, waste of energy, habitat deterioration, and negative effects on wildlife.

A *Starlight Reserve* would be an area where all the possible efforts are made to protect and, eventually, restore the pristine quality of the night. Any lighting in these areas must be of the highest quality and be an example to the rest of society. Intelligent lighting systems should be used, creating a reference and improving best-practice models for the minimisation of all the negative effects of artificial illumination at night. Within *Starlight Reserves*, any artificial lighting should only be designed to provide the necessary visual information, avoiding light noise and energy waste. Their outdoor lighting policy aims to guarantee sky quality and people's and wildlife's right to the starlight. Limiting the emission of particles into the atmosphere and promoting an intelligent, more energy efficient lighting system, contributes to the double objective of fighting against climate change and recovering starry skies.

Hence, the *Starlight Reserve* concept connects to the international movement in favour of mitigating the effects of light pollution, which is understood as the introduction by humans, directly or indirectly, of artificial light into the environment. We are currently facing a growing abuse of artificial lighting, whose impacts and consequences have not been sufficiently evaluated. But what we can be certain of is that the common factor



E 120° – 180° Critical area for skyglow experience from within urban and all areas but proportionally less impact to rural areas, distant from main light sources;

D 95° – 120° Significant contributor to skyglow, especially in rural areas. Less likely to be obstructed;

C 90° – 95° Critical zone for skyglow and obstruction seen at tens of km (in rural areas) where it is strongly dependent on aerosol scattering;

B 85° – 90° Significant contributor to skyglow seen at a distance through reflection but reflected light more likely to be obstructed by buildings, trees and topography. Produces also glare in the roadway users;

Bbis 75° – 85° Produces glare in the roadway users;

A 0° – 75° Ideal light distribution.

Figure 3. Effect on skyglow and cut-off angle, showing the relative impact of a luminaire's output contribution to skyglow. (Figure courtesy Chris Baddiley. British astronomical Association – Campaign for Dark Skies, Fabio Falchi, STIL).

of these phenomena is the loss of the capacity to observe the stars and the destruction of nightscapes, together with unnecessary impacts on people's quality of life, waste of energy, habitat deterioration and negative effects on wildlife.

The *Starlight Reserve Guide*, written with the participation of over 100 international experts and developed in co-operation with the World Heritage Centre and other organisations like the International Astronomical Union (IAU), the IAC (Canary Island Astrophysics Institute), UNWTO, the International Commission on Illumination (CIE), and the MaB Programme, provides two essential tools. On the one hand, it defines the functions that certain places on the planet can fulfil for preserving outstanding values related to starlight. On the other, it provides an efficient guide to what has been called intelligent lighting, that is, lighting that covers the real needs for artificial lighting without degrading the quality of the night sky as an essential part of the environment.

6. Sounds of Silence under the Stardome of Sights

The defence of the right to observe the stars and the preservation of our astronomical heritage is providing a new form of benefits to local communities. New expectations for identifying responsible tourist destinations and products appear before our very eyes in an enormous spectrum. Such diverse possibilities as watching starry skies, aurorae, eclipses, visits to astronomical observatories, sailing holidays featuring navigation by the stars, some pilgrimage routes, or the innovative experiences offered by desert tourism at night are becoming viable, sustainable sources of income for an increasing number of areas around the world.

Lake Tekapo, New Zealand is a widely celebrated *Starlight Reserve* designee. Boasting Mt. John, considered the most accessible observatory in the world, Lake Tekapo currently attracts 1.4 million visitors annually. The intention to ensure the continued quality of this astronomical habitat is predicted that will create new responsible and imaginative forms of tourism for generations to come. Likewise, dark sky sites at Pic du Midi in France, the MacKenzie Basin in Scotland, and Hortobágy National Park Directorate in Hungary (all under consideration for IDA's International Dark Sky *Places* program) and places such as Fuerteventura, Northern Chile, La Palma, and the Amalfi Coast, are all inspiring new economic possibilities in starlight astronomical tourism that include companion industries



Figure 4. Comet McNaught, viewed from Mt. John-Lake Tekapo (New Zealand). © F. Gunn.

such as lodging, and cultural enrichment programs that disseminate local activities and folklore. These possibilities not only draw interest from visitors, but can strengthen local ties to the region.

But, besides its role in Starlight parks and landscapes, the cultural heritage associated with astronomy also acts as motivation for many travellers nowadays. At present, new big opportunities arise for many locations and destinations in which heritage is connected with astronomy, including archaeoastronomical heritage, and intangible and oral manifestations, being them a potential attraction for the development of sustainable tourism. Stargazing could be a further activity to be included when developing a responsible cultural product.

The firmament, as a scenario for tourism in modern times, has been present as a basic reference point in historical destinations. This vital resource has almost fallen into oblivion due to tourism's rapid development, standardising and massification. The present challenge is to reintroduce this resource as a basic part of the offer for those destinations which still have a chance to recover the clarity of their night sky. A certification standard for *Starlight* tourist products and areas is being developed at present, jointly with UNWTO (World Tourism Organization) and UNESCO, in order to strengthen the arising process of *Starlight* products and destinations. It should be ready for application by the end of 2009.

Finally, the vision given by the *Starlight Initiative* takes on a special meaning in 2009, a year that celebrates two emblematic events. It is the 400th anniversary of Galileo building his first telescope and it is the 150th anniversary of Darwin's publication of his work *On the Origin of Species*. It is in this context, in which science, technology, knowledge, nature, beauty and the heritage of the star-studded sky converge, where we can better understand the scope of some creative nomination proposals that, like Lake Tekapo in New Zealand, offer new windows and references to the diversity of our common heritage: the sky.

References

- Marin, C., and Jafar, J. (eds) 2008, *Starlight: A common Heritage* (Tenerife: Instituto de Astrofísica de Canarias)
- Starlight Scientific Committee Report 2009, *Starlight Reserve Concept* <http://www.starlight2007.net/pdf/StarlightReserve.pdf>