Preserving the Skies

10 YEARS AFTER STARLIGHT DECLARATION
LOOKING AHEAD

Vision and Resolutions

La Palma 2017 - 10th Anniversary of the Starlight Declaration
April 20, 2017

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10 YEARS AFTER:
LESSONS LEARNED

In April 2007 the first World Conference in Defence of the Night Sky and the Right to Observe the Stars was organised by the IAC (Instituto de Astrofisica de Canarias) and the La Palma Biosphere Reserve with the support of UNESCO, UNWTO, IAU and other international agencies and organisations. The Conference brought the Starlight Declaration into being. This historical declaration was the first international agreement aimed at preserving the skies and defending the natural and cultural values associated with observing the stars. The “Declaration in defence of the Night Sky and the Right to Starlight” opens with the statement:

“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.”

Ten years later we have met again on the island of La Palma for the "Preserving the Skies” International Congress in order to keep the spirit of the Starlight Declaration alive, to analyse the advances made in this time and to look forward, in search of new alliances, avenues for action and guides in defence of this common heritage of humankind.

Despite the many advances made in this decade, it is important to acknowledge that the planet's skies are still under threat from light pollution. The new World Atlas of Light Pollution (Falchi et al., 2016) shows a significant increase in artificial sky brightness through time and across the continents. We are thus facing the degradation of a legacy with strong cultural, scientific, environmental, aesthetic and health implications.

Most people in the world today, including astronomers, do not have the opportunity to see the Milky Way and its stars in the sky and this situation could worsen if we consider the rapid process of urbanisation and the lack of commitment to adopting intelligent and responsible lighting solutions. According to UN figures, about 3.3 billion people, more than half the world's population, live in cities. It is anticipated that within two decades this figure will increase to 5 billion. By then, more than 75% of the world population will live in urban areas, exacerbating the levels of light pollution and seriously impacting the environment.

Spite these dramatic outlooks there have been signs over the years that indicate that this process can be reversed in the near future. Preservation of the skies is no longer the sole concern of astronomers. For example, if we consider the environmental protection dimension, we have to recognise there has been big growth in research about the importance of natural light in ecological processes. Here is also a growing body of scientific literature on the impacts of light pollution on species and ecological relationships. Managers of natural areas are starting to seriously consider the need to adopt measures in relation to night sky quality to preserve the ecological integrity of

natural environments and open new opportunities to enjoy nature. National Parks and protected areas in several countries have now evolved to supporting protection of this environmental right to a natural night sky. Suffice it to say that we now have 96 protected areas that have been recognised as dark sky places by the Starlight Foundation, IDA (International Dark Sky Association), RASC and other certifications (DSAG, 2017).

As a precedent, it should be mentioned that in 2009 the Starlight Reserve concept emerges with a holistic vision that combines the right to starlight, biodiversity conservation, astronomical cultural heritage defence, sustainable development and climate change mitigation. The document was adopted during the International Workshop and Expert Meeting ”Starlight Reserves and World Heritage – scientific cultural and environmental values”, held in Fuerteventura, organized by UNESCO World Heritage Centre, UNESCO’s Man and the Biosphere (MAB) Programme, IAC, together with representatives from IAU, UNWTO and IUCN among others.

Aspects related to increasing public awareness in astronomical culture and appreciation of cultural values associated with the starry sky have triggered much of the efforts made to defend the night sky in recent years. The International Year of Astronomy in 2009, promoted by UNESCO and IAU, was an unprecedented undertaking the impact of which is still being felt. Throughout this time important public awareness raising campaigns have been launched on the importance of dark skies, astronomy and light pollution, including the use of new information technologies such as Globe at Night. The experience accumulated from successful stories should pave the way for future initiatives.

The dissemination of astronomy and associated scientific and cultural values should be considered as basic content to be included in educational activities. Education is the major agent of transformation to recover and improve our astronomical and environmental culture. Therefore, it is necessary to improve education for achieving the right to observe the stars within a dark skies recognition framework, since through educating future citizens we will help reorient the process of cultural loss of the sky. This will empower the world's 60 million teachers to become key agents of change, and through them reach local authorities and governments.

Cultural heritage related to astronomy is once again starting to be appreciated and valued. A good example of this is UNESCO's Astronomy and World Heritage Thematic Initiative. The Initiative aims to establish a link between Science and Culture towards recognition of the monuments and sites connected with astronomical observations dispersed throughout all the geographical regions, not only scientific but also the testimonies of traditional community knowledge. However, there is still a long way ahead in this field with the support of researches, local communities and governments.

For the first time science has become a resource for tourism, the world's largest industry, with an amazing capacity to mobilise resources and knowledge. Tourism under the stars and its specialised products such as astro-tourism have made great and amazing advances in many parts of the planet that still enjoy pristine skies. We are

talking about a form of tourism that is essentially sustainable, based on knowledge, and which will contribute to the development of many rural and isolated communities. Sustainable tourism is likely to become one of the most important drivers for the preservation of the night skies on all latitudes.

Tourism practices related to skyscapes has increased in popularity during the past few years, adding value to offbeat tourism destinations offering high quality night skies and astronomical or archaeoastronomical heritage. A new generation of tourist destinations forges ahead into the geography of the planet by integrating the starry skies as one of its basic attractions. It should be remembered that the Starlight Destination concept was presented at the end of 2009 at the UNWTO, as a result of the work carried out by a large group of experts led by the Starlight Foundation in coordination with the UNWTO.

Enormous strides have also been made in the past decade in terms of lighting technology and knowledge. Technical solutions are now available to provide adequate lighting whilst limit light pollution. The lighting industry is capable of providing luminaires, lamps and intelligent systems that allow its impacts to be minimised. Thus, technology and availability are not barriers. However, in this process of accelerated innovation we are witnessing the LED revolution. The light-emitting diode (LED) is transforming the way we light up our cities and towns offering a unique opportunity to improve energy efficiency and incorporate intelligence into lighting. But the serious challenge we now face is the progressive and spectacular indiscriminate use of the blue-rich white LED, which is one of the most pollutant and most harmful lighting sources for the night environment and for human health. Recent experience shows that lack of knowledge or disinterest in its collateral effects has changed an acceptable and revolutionary technology into a serious problem on a global scale that has to be dealt with as a matter of urgency.

As expected, the international astronomical community has redoubled its efforts to ensure the protection of the night skies in this period. The XXVIIth IAU General Assembly in August 2009, in Rio de Janeiro (Brazil), unanimously passed Resolution B5 in Defence of the Night Sky and the Right to Starlight, recognizing the principles expressed in the Starlight Declaration. Since then, the IAU has been significantly increasing its work in this line, particularly through the Division C (Education, Outreach and Heritage), or with the creation of commissions and working groups such as the Commission C4 (World Heritage and Astronomy), WG Dark and Quiet Sky Protection, WG Astronomical heritage in danger and WG Achieving Sustainable Development within a Quality Lighting Framework.

However, in spite of these unquestionable achievements, much more progress needs to be made. Our vision is based on the idea that observing the starry night sky from any location in the world should be considered a value to be preserved for the humankind and for the future generations.

Therefore, the participants at the "Preserving the Skies" International Congress meeting in La Palma, Canary Islands, Spain, on April 20, 2017, adopt the following recommendations and calls for action inspired by the Starlight Declaration:

A CALL TO ACTION
STATEMENTS AND RECOMMENDATIONS

RECOVERING CULTURAL VALUES OF STARLIGHT

Statement

The sky is the only common natural landscape for all of the inhabitants of Earth and curiosity about the starry sky has captured the attention of all our planet's cultures throughout human history. A little more than 100 years ago, most citizens of the planet could walk outside at night even in a city and see the Milky Way galaxy arch across the night sky. Being able to see thousands of stars was part of everyday life, inspiring artists like Van Gogh or musical composers like Holst or writers like Cervantes, Shakespeare or Omar Khayyam. By allowing artificial lights to wash out our starry night skies, we are losing touch with our cultural heritage. We are also losing touch with what could inspire future generations.

The light of the stars and other heavenly bodies has always enriched the spectacle of terrestrial nature as well as the human habitat, creating reference landscapes traditionally perceived by people as an integral part of their natural and cultural heritage.

Regaining a starry sky and integrating it into our current culture does not depend solely on technological solutions and the management of outdoor lighting. It also depends on the capacity to convey its value through education, information and training of all citizens, particularly the new generations. Educating our children on the importance of preserving access to an unpolluted night sky for all humankind will help ensure the sustainability of starlight for all.

Heritage relating to astronomy stand as a tribute to the complexity and diversity of ways in which people rationalised the cosmos and framed their actions in accordance with that understanding. This close and perpetual interaction between astronomical knowledge and its role within human culture is a vital element of the outstanding universal value of certain and significant sites. These material testimonies of astronomy, found in all geographical regions, span all periods from prehistory to today.

Calls for actions and recommendations

- Recognize the need to protect and recover the starry sky as the universal cultural landscape of humankind.

- Stress the importance of developing programs and initiatives aimed to inspire and motivate children and educators to enjoy and to care for the night sky as guardians of the starry skies and its associated cultural values;

- Urge governments and international organizations to support the formulation and implementation of educational policies that promote a better knowledge of the importance of preserving the skies for astronomy, environment and culture;

- Encourage taking all necessary measures to raise public awareness of the issues of and solutions for light pollution by educating children, since the children of today will be tomorrow's leaders and change-makers. Educating our children on the importance of preserving access to an unpolluted night sky for all humankind will help ensure the sustainability of starlight for all;

- Recommend to establish a strong professional network with pre-service teacher courses as well as the in-service education of teachers at all levels, education policy-makers, and authors of educational materials, with a final target being to integrate the concept of sustainable lighting and to bring the topic of light pollution to the national educational environmental curriculum;

- Call upon governments, international agencies and local authorities to take the necessary measures to protect the sites with relevant astronomical value for humanity that are currently at risk;

- Further encourage greater action by local communities to safeguard and recover intangible heritage related to astronomy, due to its extreme vulnerability and endangered status.

- Encourage State Parties adhered to the World Heritage Convention to identify potential astronomical and scientific sites in their Tentative Lists and to support possible nominations to the World Heritage List;

- Support the Portal to the Heritage of Astronomy as an exceptional tool to raise awareness of the importance of astronomical heritage worldwide and to facilitate efforts to identify, protect and preserve such heritage for the benefit of humankind, both now and in the future.

PRESERVING BIODIVERSITY AND HUMAN WELL-BEING

Statement

We are creatures of light, but in recent centuries our technology has enabled us to push back the frontier of darkness, extending our work and leisure time well into the hours of twilight and darkness. We tend to forget, however, that ecosystems and wild species operate 24 hours each day, seven days each week. They have evolved to cope with, depend on and take advantage of natural darkness. As over half of the creatures living on this planet are nocturnal, any degradation in the quality of sky will have a profound effect on their behaviour and on the equilibrium of the biosphere.

A night sky without artificial light is therefore vital to the proper functioning of natural ecosystems. Artificial lighting affects species migration patterns, predator-prey relationships, and the circadian rhythms of many organisms, to name just a few of the consequences of light pollution. Natural darkness is also essential to a full appreciation of our surroundings, to satisfy curiosity, to appreciate our environment in all its facets, and to preserve our diverse cultural integrity. However, compared to climate change, acid rain, exotic species, habitat destruction and other stresses, the need for natural darkness and the impacts of artificial lighting are often overlooked as we strive to protecting biodiversity and to appreciate the natural world.

Like animals, humans evolved to the rhythms of the natural light-dark cycle of day and night. The spread of artificial lighting means most of us no longer experience truly dark nights. Current research suggests that artificial light at night can negatively affect human health, increasing risks for obesity, depression, sleep disorders, diabetes, breast cancer and more. Besides, exposure to light during the night decreases the secretion of melatonin in most animals, humans included. Based on the evidence, the International Agency for Research on Cancer has added this form of pollution to the list of group 2A (probably carcinogenic to humans) shift work that involves circadian disruption.

Calls for actions and recommendations

- Call upon environmental and natural resource management agencies to recognize that outdoor artificial light should be subject to effective standards in order to help restore and/or maintain the ecological integrity of natural areas.

- Recognize that the ecology of night should be urgently considered in relationship to artificial light in the world network of protected areas, integrating the dimension of the dark sky in the management of these sites that comprise more than 15% of the surface of the planet;

- Encourage natural area managers, interpreters, and non-governmental organizations involved to promote awareness of dark sky values and the need for and methods of reducing outdoor artificial light;

- Recommend that universities, science-funding agencies, and scientific institutions foster and support research into the nocturnal aspects of biological and ecological function;

- Urge protected area management authorities to develop visitor activities that lead to public appreciation and understanding of nocturnal ecology and the night sky;

- Also urge health authorities to inform citizens about the harmful effects of light pollution, especially blue-rich light.

- Call upon UNESCO's Man and the Biosphere Programme (MAB) to encourage their World Network of Biosphere Reserves to protect their dark skies for biodiversity conservation and to search for sustainable lighting solutions to reduce greenhouse gas emission.

- Recognize and support the work led by the International Union for Conservation of Nature (IUCN) through the establishment of Dark Skies Advisory Group (DSAG);

PAVING THE WAY TOWARDS A NEW LIGHTING CULTURE

Statement

Light pollution is the alteration of natural lighting levels in the night environment, due to artificial lights, especially if misdirected, inappropriately used, or excessive light. Too much light pollution washes out our view of the Universe, result in an increase in the energy consumption, interferes with astronomical research, disrupts ecosystems, and affects the health and safety of humans and wildlife. We are facing a global problem that requires a multi-disciplinary approach to be studied and solved.

The over-illumination has become a growing phenomenon around the world. Artificial light at night is often improperly associated with the sense of security, wealth and modernity. Inefficiency and excess of artificial light increases energy consumption and it is economically unjustified. It also increases the level of emissions that contribute to climate change. By contrast, today more than 1.3 billion people worldwide lack access to electricity.

The move towards a sustainable and low-carbon lighting approach is a major challenge considering the current state of the lighting systems. 500 million outdoor lighting luminaires are installed in the world and most are more than twenty years old and do not meet current energy efficiency and environmental criteria. One third of the world's roads are still lit by technology dating back to the 1960s.

The reduction of light pollution, energy savings and recovery the starry sky, should be an integral part of a new lighting culture committed to the climate and the sustainable development. Today there is sufficient knowledge and competitive technology available to guarantee a proper use of outdoor lighting causing much less light pollution.

Nowadays, we also witness the emergence of intelligent lighting. Bringing intelligence into many outdoor lighting applications may advance in future "green" Digital Life. The larger roll-out of intelligent lighting systems in cities will be part of the creation of sustainable smart cities: cities where lighting innovation is interlinked to other smart city networks (communications, renewable energy, building or traffic management systems). But the great challenge is to complete the transition to new smart lighting technologies thus restoring and recovering the natural night environment and night sky.

Light pollution, unlike other forms of contamination and waste, remains largely overlooked and unregulated in a great part of countries and municipalities. We are convinced that the great cultural and technological change in lighting will come from the local administrations committed to the defence of the citizens quality of life and its capacity to generate ordinances, by-laws and initiatives regulating light pollution.

Calls for actions and recommendations

- Stress the need to consider, as a general principle, that the first step toward efficiency is to ban the unnecessary light;

- Suggest that urban and non-urban infrastructure management authorities regulate and control outdoor lighting in the areas under their jurisdiction so as to achieve just the right amount, spectrum and timing of outdoor lighting necessary for public use and safety;

- Urge cities and communities to install outdoor lighting that maximizes energy efficiency by reducing waste from over lighting, unwarranted lighting, uplight, glare and light trespass;

- Increase efforts to disseminate and replicate successful ordinances and regulations on responsible outdoor lighting among local authorities;

- Promote new tools and mechanisms for the monitoring and the measurement of light pollution within everyone's reach;

- Push for the adoption of standard rules that allow a substantial reduction of the levels currently used in outdoor lighting, guiding the market of LED technologies toward a more environmentally friendly lighting;

- Properly define the concept of eco-friendly lighting technologies, which besides energy efficiency should take into account the control of light pollution in all its aspects;

- Consider a minimum of requirements for outdoor lighting installations friendly with the environment, taking into account the current state of the art technology (See Annex 1).

- Call upon UN SE4ALL Energy Efficiency Committee to provide high-level support to the objective of reducing light pollution and contribute to doubling the global rate of improvement in energy efficiency by 2030;

- Urge the United Smart Cities program, initiated by UNECE and other industrial partners, to consider sustainable and intelligent lighting among its objectives;

- Further encourage all stakeholders to create a Starlight Task Force to promote a responsible and sustainable outdoor lighting with the support of industry, the scientific community, research centres, astronomers, international organisations and networks of cities and local authorities;

THE UNIVERSAL VALUE OF DARK AND QUIET SKIES FOR ASTRONOMY

Statement

The free and unrestricted observation of the sky from the ground and from space is a value both for the scientific research community and — even more importantly — for humankind as a whole.

The scientific 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 as a resource of extraordinary value for the progress of knowledge, as it has been throughout history. Dark and quiet skies are still the only windows to our knowledge of the greater universe.

Historically, ground-based observatories have provided the vast majority of our knowledge of outer space. However, present-day technical and scientific requirements restrict suitable areas to very specific and limited locations offering good conditions for the development of astronomy, and of optical and infrared astronomy in particular. There are only a few places on the planet where we find this unique combination of environmental and natural circumstances: well-conserved spaces with very little alteration to natural starlight. They are called Windows to the Universe.

The recent decades have seen an enormous improvement of the research infrastructure of large astronomical institutions. This is true, in particular, for the data collection capabilities, i.e. telescopes (for the UV, optical, and IR wavelengths), antennae (for the radio frequencies), and more recently, detectors for neutrino and gravitational wave events.

The sites considered as outstanding for observing the skies, do host the mast updated and advance technologies. These technologies are planned to gain the most from the particularly gifted nature of the sites. Future implementations as laser beacons should become standards and thus should also be properly regulated.

In this context, the sites of the large world astronomical observatories need to be protected against artificial light and electromagnetic pollution, particularly if one considers its essential role for the development of modern astronomy and the relevant financial investment for their construction and operation.

Calls for actions and recommendations

- Urge governments and responsible authorities to make tangible progress in stopping the encroachment of artificial sky glow and radio-frequency interference on major astronomical research facilities.

- Raise public awareness to prevent the losses caused by light pollution for all observatories and for the fundamental right to starlight as in IAU Resolution 2009-B5.

- Encourage governments to define and protect “dark and quiet areas” in their countries that provide optimal scientific observing conditions and offer to their citizens the possibility of enjoying the observation of the starred sky.

- Open a discussion forum to decrease the contamination produced by modern observing technologies like laser beacons.

- Encourage relevant national and international authorities to set up legal policies and guidelines for the protection of astronomical quality of areas suitable for observational research and/or meriting astronomical world heritage status.

- Join efforts to develop the Window to the Universe Initiative, aimed at safeguarding the world's outstanding sites for astronomical observation, the quality of their skies and its associated heritage.

- Call upon States Parties to the World Heritage Convention to cooperate towards a potential serial and transnational nomination to cover outstanding heritage and observation sites, such as the Canary Islands, Chile or Hawaii.

STARRY SKIES AS A DRIVER FOR SUSTAINABLE DEVELOPMENT

Statement

The new 2030 Agenda for Sustainable Development represents a significant step forward in the recognition of the contribution of Science, Technology and Innovation (STI) to sustainable development. In this context, the preservation of our night skies opens multiple opportunities to contribute to the objectives outlined in the 2030 Agenda and the UN Sustainable Development Goals (SDGs).

Reducing light pollution and promoting sustainable lighting contribute to the mitigation of climate change, as well as the target of double the global rate of improvement in energy efficiency by 2030.

Preserving the dark skies, in particular in protected areas covering 15% of the planet's surface, will make a significant contribution to halt the loss of terrestrial and marine biodiversity. It also contributes significantly to ensure healthy lives and promote wellbeing for all.

Clear night skies provide sustainable income opportunities to local communities through activities such as astrotourism. Many disadvantaged areas could benefit from this new type of tourism. Astrotourism epitomizes the tendencies towards more sustainable tourism experiences, based on conservation of natural resources, knowledge, and science, potentially enriching the traveller and the host communities. For the first time it is possible to bring science and tourism together.

Astro-touristic initiatives contribute to the dissemination of knowledge and human capital formation, both among the visitors and within the host community. Therefore, it can act as a potential instrument for sustainable development. The best destinations for astrotourism have very special characteristics, which makes for a likely favourable strategic positioning in domestic and even international markets. However, astrotourism consumers demand high knowledge content and excellent quality in their visits. This requires a professional approach to resource use and conservation, product development, and adequate provision of ancillary services in the destination.

In fact, astronomy is a unique and cost-effective tool for furthering sustainable development, because of its technological, scientific and cultural dimensions.

Calls for actions and recommendations

- Support and recognize the initiative of the World Tourism Organization (UNWTO) to launch a working group on scientific tourism, led by the Starlight Foundation, affiliate member of the organization. Open to UNWTO Member States and Affiliate Members, this working group seeks to be inspired by the scientific field to innovate in the development of tourism products. It begins its

journey with astrotourism, with a focus on the research and the development of pilot projects that contribute to position it as a tool of sustainable development for destinations around the world.

- Encourage the UNESCO Sites, in particular biosphere reserves, to use their night sky as a tool for education, research and for sustainable economic activities such as astrotourism.
- Promote and facilitate sharing and exchange of know-how and best practices to inspire the replication of success stories on astrotourism and sustainable lighting solutions at destinations.
- Encourage scientific institutions, astronomical centres and related agencies to cooperate with local communities in the formation and enhancement of tourist and educational resources related to the starry sky.

Annex 1

PROPOSED REQUIREMENTS FOR OUTDOOR LIGHTING

1. Energy Consumption
The target energy consumption for all outdoor light sources in a given municipality per capita per year should be lower than 15 kWh.

2. Blue-Light Content
Correlated Colour Temperature (CCT) of all luminaires must be equal or lower than 2200 K AND must emit under 500 nm energy flux lower than 6% of the total emitted in the entire visible range.
In case of an average illumination level below 5 lx it is allowed to use luminaires with CCT from 2200 K up to 2700 K AND energy flux must be lower than 10% of the total emitted in the entire visible range under 500 nm.

3. Upward Light Output Ratio
The Upward Light Output Ratio (ULOR) of a luminaire must be 0.0%. This needs to be valid during the whole lifetime of the luminaire and also when the luminaire is dirty.

4. Maximum Luminance
The luminance of the main roads in cities and towns is not allowed to exceed 0.5 cd/m2.

5. Curfew
For all luminaires there must be implemented a reduction of power and lumen output outside peak traffic hours from 100% down to 10% or less in case of adaptive lighting systems, or at least 50% reduction in absence of adaptive lighting.

6. Illumination Utilisation Factor
At least 70 % of the lumen output must target the road/street/walking area. Lower utilisation factor down to 40 % is allowed for narrow paved bicycle and paved pedestrian paths.