

New Zealand Starlight Conference

Abstracts

Session 1

Principal Author/Presenter:

Name: **Ruskin Hartley**

Institution: DarkSky International

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Title: The hidden costs of light: How preserving natural darkness protects our world.

Abstract: Light pollution is increasing at an alarming rate of 10% annually, posing significant threats to our environment, health, and cultural heritage. This talk explores why reclaiming our night skies matters, highlighting the urgent need to reduce the overuse of artificial light and champion responsible lighting practices.

Excessive artificial light disrupts ecosystems, affecting nocturnal wildlife, including birds, insects, and marine species whose survival depends on natural darkness. It also impacts human health, contributing to sleep disorders, increased stress, and chronic conditions. Beyond these effects, light pollution erodes our cultural heritage, disconnecting us from the stars and the traditions tied to them.

The journey towards better lighting involves adopting practices like shielding fixtures, using warmer light temperatures, and illuminating spaces only when necessary. These actions can significantly reduce light pollution while maintaining safety and functionality. It's not just about turning off lights; it's about lighting smarter to protect our environment and well-being.

New Zealand has a unique opportunity to lead as a Dark Sky Nation, demonstrating how a country can balance modern needs with preserving its natural nightscape. By embracing innovative lighting policies, engaging communities, and promoting astrotourism, New Zealand can inspire others to take action. This approach offers environmental, economic, and cultural benefits, positioning New Zealand as a global advocate for the night.

This talk invites the audience to consider the broader impacts of light pollution and the collective actions needed to protect our skies. By making thoughtful choices, we can ensure the night remains a vital and protected part of our world, enhancing life on Earth for generations to come.

Principal Author/Presenter:

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Title: What to report in studies of anthropogenic light and light pollution

Abstract: As research on light pollution rapidly expands, inconsistencies in reporting light exposure and confounding factors limit our ability to draw robust conclusions across studies. This presentation dives into the critical need for standardized reporting in light pollution research, offering practical guidance to ensure that future studies accurately represent experimental conditions and outcomes. Drawing from a systematic review of hundreds of publications, we highlight key shortcomings in current research, propose best practices for documenting light conditions and biological responses, and emphasize the importance of interdisciplinary collaboration to enhance the scientific rigor needed for effective light pollution mitigation.

Principal Author/Presenter:

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Title: Light vs. Dark: Navigating night sky perceptions in Aotearoa New Zealand

Abstract: Stemming the rapidly increasing emission of light into the environment in Aotearoa New Zealand, as in many other places, is hampered by a lack of awareness about its impacts. A fast change in awareness and public engagement is hence required to preserve humanity's right to access the night sky and reduce negative impacts of light pollution. However, we do not understand the way the New Zealand public currently perceives light at night. When do they feel it is important to have the surroundings lit, and when and where would they prefer to have it dark?

This talk combines analyses on the trends of the emission of light into the nights of Aotearoa (Cieraad & Farnworth, New Zealand Journal of Ecology 2023) with the results from a recent national population survey aiming to assess attitudes to darkness and artificial light at night in Aotearoa New Zealand. It addresses two key questions: (1) Is there evidence of a shifting baseline regarding the value of the darkness of the night sky? Do people who live in light-polluted places and have less exposure to the dark night sky value natural darkness differently than people who are accustomed to darkness at night? and (2) Do people display situational-dependency in the way they value light and dark at night? That is, can we quantify for different settings (e.g. a city vs a natural environment) the importance of different uses/benefits of light (including lighting for traffic safety, personal safety and security, decoration, advertising) and darkness (including celestial observation, sense of peace, natural rhythm for people, flora and fauna, spiritual connection etc)?

Answers to these questions will be crucial to develop effective light pollution mitigation

options in Aotearoa New Zealand.

Principal Author/Presenter:

Name: **David Welch**

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Title: Dark Sky Places of the World - how they vary and where they are

Abstract: This talk describes how the Dark Skies Advisory Group relates to the International Union for Conservation of Nature. It explains that to assess international progress in establishing dark sky places a comprehensive list is needed. For this, a systematic classification of dark sky places was developed due to the multiplicity of naming styles and their alternate meanings around the world. This class system is modelled after the IUCN's protected area categories. The dark sky place classes are:

- 1 Dark Sky Astronomy Site;
- 2 Dark Sky Park with 3 sub-classes;
- 3 Dark Sky Heritage Site;
- 4 Dark Sky Outreach Site with two sub-classes;
- 5 Dark Sky Reserve; and
- 6 Dark Sky Community with two 2 sub-classes.

As of August 2024, twenty-two agencies have been involved in granting arms-length, peer-reviewed certification of 379 dark sky places in thirty-seven countries. The first was Lake Hudson Recreation Area, USA, established in 1993 under Michigan state legislation.

Torrance Barrens Conservation Area in Canada in 1999 was the first to be recognized by an astronomy society. The largest is Wood Buffalo National Park in Canada at 4,400,00 ha. The smallest is El Centro Interpretación Cielo Gorafe in Spain at 0.2 ha. For many years western and central Europe and North America dominated the list, but now Australasia, Chile and China are well represented. The Arab world, Africa and the rest of South America are yet to catch up. There is a rapidly increasing adoption by small communities, but large urban dark sky places are not yet common.

Session 2

Principal Author/Presenter:

Name: **Susan Mander**

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Title: Trends and Impacts of Outdoor Lighting

Abstract: Anthropogenic light pollution is a global problem that requires interdisciplinary solutions. This talk aims to set the scene from a lighting design viewpoint, and overviews outdoor lighting trends and their impacts.

The presentation introduces key concepts, such as mesopic vision, colour rendering, and correlated colour temperature (CCT). Guidance is also given on how to interpret spectral graphs, enabling in-depth discussions to extend beyond CCT, a value that has limitations.

A historical context is given by comparing electric lighting trends through the ages, from technologies first implemented over 100 years ago to modern-day light-emitting-diodes (LEDs). By considering properties such as energy efficiency, light control, switching capabilities, and spectral composition, key differences between these light sources are highlighted.

The impacts of light pollution on humans and the environment are introduced, with a particular emphasis on the blue-rich spectral emission of some LED products. Mitigation strategies are discussed, which aim to achieve a balance between technological innovations, environmental stewardship, and human needs. A brief overview of measurement tools is also given, as these provide crucial information on the extent and trends of light pollution.

Principal Author/Presenter:

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Title: Road Lighting Design: Strategies for Minimizing Light Pollution and Ensuring Safety

Abstract: Road lighting design plays a critical role in ensuring public safety, but it can also contribute to light pollution, disrupting residents, wildlife, and the atmosphere. This presentation explores effective strategies for minimizing spill lighting and glare while complying with relevant standards such as AS/NZS 4282 for Obtrusive Spill Lighting and AS/NZS 1158 for Road and Public Lighting.

Key topics include selecting appropriate correlated colour temperatures (CCT) to balance safety and environmental impact, meeting spill lighting Standards compliance and collaborating with stakeholders like Councils and road controlling authorities. We will discuss design techniques such as choosing the right LED optical distribution, using dark-sky or wildlife-approved LED luminaires, and integrating centralized management systems (CMS) for flexible dimming and light control.

By adopting these strategies, road lighting designers can create safer public spaces while protecting the natural environment, supporting the broader goal of reducing light pollution and preserving dark skies. The presentation aims to provide practical insights and foster discussions among professionals seeking to align road lighting with environmental sustainability.

Principal Author/Presenter:

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Title: Dark Sky Protection in Uruguay

Abstract: In the last two years, Uruguay has made significant progress in protecting the natural night sky. In September 2022, an agreement was established between the Intendencia de Montevideo (Montevideo City Government) and the Universidad de la República (University of the Republic), through the Centro Universitario Regional del Este (Eastern Regional University Center - CURE) and the Faculty of Sciences, to study the environmental impact of the transition to LED lighting. This project has an unprecedented interdisciplinary team in the country, made up of biologists, astronomers, engineers, architects and lighting technicians. As part of the agreement, CURE is conducting sky brightness measurements and satellite data analysis, while the Unidad Técnica de Alumbrado Público (Public Lighting Technical Unit - UTAP) is adapting the lighting fixtures, limiting new acquisitions to a maximum color temperature of 3,000 K. The team is developing recommendations to mitigate light pollution in Montevideo and is working on creating regulations that will be implemented as a departmental decree, in collaboration with other entities, such as the Uruguayan Institute of Technical Standards.

In 2023, an interdisciplinary working group, comprising CURE educators and researchers as well as regional tourism entrepreneurs, was formed with the goal of developing a regulatory framework to reduce light pollution in the Department of Rocha. This proposal was presented to the Rocha City Government and is currently under evaluation by the relevant authorities. We are systematically measuring sky brightness and taking photographic records of the night sky in protected natural areas of the Rocha department, including the Ambá region, which we are proposing for certification as a dark sky place by DarkSky International—a milestone for our country. Ambá is a non-profit environmental organization dedicated to restoring the connection between humans and nature and regenerating ecosystems, with sites that feature exceptionally dark skies.

Additionally, CURE continues to provide free consulting services to protected natural areas and community groups in the departments of Canelones, Maldonado, and Rocha. These consultations include light pollution assessments, the development of mitigation recommendations, and the delivery of workshops and awareness talks. Some of these protected areas have already begun to include the night sky as a conservation target. We will be presenting an evaluation of the results and progress achieved to date.

Principal Author/Presenter:

Name: **Brian Boyle**

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Title: The Kawarau-Gibbston Dark Sky Park

Abstract: The Kawarau-Gibbston Dark Sky Park was approved by DarkSky in May 2024. Lying between Queenstown and Cromwell, in a world-renowned wine-growing region, it offers a number of opportunities and challenges to promote dark sky to a broader public. I discuss these issues, along with key learnings from both the application process and the initial operations of the Park.

Principal Author/Presenter:

Name: **Steve Butler**

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Title: Dark Skies By Design

Abstract: The design of outdoor lighting is a technically demanding process. Whether this process can be declared a success depends on how and against which measures it is assessed. The design process is initiated by a need, and refined against a series of performance objectives. The thoroughness of the performance objectives will contribute to whether the final installation is a success.

This talk will explore the dark sky community's role in establishing successful lighting projects.

Session 3

Principal Author/Presenter:

Name: **Joan Marie Galat**

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Title: Dark Matters: Using Stories to Promote Dark Skies

Abstract: Storytelling is a powerful tool you can use to inspire others to consider the effects of light pollution. Science author Joan Marie Galat demonstrates ways to link personal and cultural tales to the importance of dark skies, based on her books: Dark Matters—Nature's Reaction to Light Pollution and the Dot to Dot in the Sky series. Discover how you can use stories to build emotional connections that grow awareness, launch discussion, and strengthen your advocacy for a pristine starry night sky.

Principal Author/Presenter:

Name: Peter Swanton

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Title: The Impacts of Light Pollution on Australian Indigenous Sky Knowledges

Abstract: Since time immemorial human beings have looked to the stars for answers to the many different cultural, philosophical or scientific questions. Indigenous knowledge systems from communities across Australia embody all of these sentiments in the formation of their world view or cosmology. Indigenous astronomy plays a huge part in informing many aspects of their society, such as navigation, finding food, plants and other resources, seasonal

tracking and weather prediction, as well as dance, song and ceremonial practices, the stars are integral to the cultural structure of the community. However, as society has evolved alongside technological advances, our ability to see the stars is becoming ever more difficult due to the rising impact of light pollution. Even in Australia, a large continent which boasts some of the darkest skies in the world has its problems with light pollution. From the dense major cities which house the majority of its population, to a large mining industry that runs 24/7, and the unavoidable impacts at the newest frontier that is satellite mega-constellations, Indigenous communities' connection to the night sky, and the associated sky knowledges, is increasingly under threat. This talk will briefly introduce some key examples of Indigenous Sky knowledges and highlight the potential threat that light pollution presents to those knowledges.

Principal Author/Presenter:

Name: **Harrieth Godwin Mtae** and **Ladislaus Batinoluho**

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Title: Exploration of Astronomical Traditional Knowledge: A Tool for promoting astrotourism in Tanzania

Abstract: There is an inadequate understanding of astronomical traditional knowledge necessary for promoting astro-tourism in Tanzania. There is an estimated total of 125-130 ethnic groups in Tanzania, classified into four major categories, including Bantu, Cushite, Nilo-Hamite, and San. Each ethnic group has its cultural understanding of some astronomical bodies, especially the sun, moon, stars, planets, and meteorites. There is a lack of unified information on the way the various ethnic groups understand some of these bodies in the world of astronomy. If ethnic groups could maintain cultural profiles of some astronomical objects, it could promote astro-tourism in Tanzania. Using qualitative approaches, the study established that; each ethnic group has its own naming of the astronomical objects; Each ethnic group has its understanding of the astronomical bodies; there are contrasts and similarities in the understanding of the astronomical bodies among ethnic groups; Application of astronomical traditional knowledge among the ethnic groups; and Ethnic group's opinion over formal astronomy. It is important to embrace the traditional knowledge of astronomical cultural heritage, which is vital for astro-tourism development in Tanzania. Future research can focus on the preservation of the rich astronomical traditional knowledge for future generations.

Principal Author/Presenter:

Name: **Kyra Xavia**

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Title: Embracing Darkness - The Benefits of Nocturnal Placemaking

Abstract: This talk delves into an innovative, much-needed, yet seldom applied concept that can transform the way planners and designers approach projects and developments in urban zones, (and elsewhere, as this concept has wide appeal and universal application).

Nocturnal placemaking is a deliberate and conscious design approach that prioritises darkness as an essential element in creating safe havens that support both ecology and human health,

particularly within urban environments, as these are often the most light polluted.

In order for life to flourish, designs need to respect Nature and resources, and also support natural biological rhythms and cycles of humans and wildlife. This matters because in built-up areas, two of the most critical external cues foundational for health and well-being, namely, natural daylight and darkness, are significantly altered.

Rather than thinking of darkness as a neutral, empty backdrop with no benefits, projects start with darkness as a valuable resource. The use of lighting is questioned, and it's only introduced if it respects nocturnal placemaking and protects a view of the stars. This is where nocturnal placemaking emerges as a crucial tool for planners and designers, and as an important consideration in general.

Just because we can brightly light an area, doesn't mean we should. (With easy access to an abundance of overly bright lighting these days, darkness is becoming a sort-after luxury.) In fact, knowing what we do about the adverse impact of lighting at night (a recognised pollutant with harmful effects), it's untenable to use it without due diligence and care.

As we're becoming increasingly aware, darkness preservation not only supports flora and fauna, it also maintains human circadian rhythms, and respects the night sky. For wildlife, this can mean unlit vegetation, and the creation of habitat corridors and night gardens to foster biodiversity, ecological resilience, and the health of wildlife populations.

For humans, well-designed and executed lighting enhances living conditions and life quality, and supports rest and recovery.

To demonstrate, you'll be shown some award-winning case examples, including images of interior hotel lighting, an astrotourism destination, pathway lighting, outdoor seating, and architectural/landmark lighting, that clearly show the improvements made by utilising nocturnal placemaking, revealing how these principles can be effectively implemented in various settings.

In conclusion, you will come away from this talk with the knowledge required to recognise what truly exemplifies responsible, dark sky compliant lighting, and most importantly, have the insights needed to apply beneficial nocturnal placemaking.

Session 4

Principal Author/Presenter:

Name: **Yana Yakushina**

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Title: Light Pollution Regulations and Where to Find Them

Abstract: In recent years, light pollution has become a significant concern on political and legal agendas. International frameworks and various national governments have begun adopting regulatory measures to tackle the problem of the disappearance of natural darkness, leading to a range of approaches aimed at addressing light pollution. This presentation will provide an overview of the current regulatory frameworks designed to address light pollution

and its various adverse impacts, as well as discuss the factors that have triggered the adoption of these measures.

The presentation will classify regulatory approaches based on the nature of the instruments adopted—such as policies and laws, whether binding or non-binding—and based on their areas and levels of implementation. The aim is not only to present these approaches but also to demonstrate that light pollution is becoming an increasingly pressing political issue that requires coordinated action to address this transboundary problem. Additionally, the classification provided will help to clarify what measures have been adopted, where they have been implemented, and what best practices can be identified in order to assess the effectiveness of these measures.

The preprint of the paper is available here:

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4933953

Principal Author/Presenter:

Name: **Christopher L. Martin**

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Title: Dark Sky Laws and Regulations from Around the World: Best Practices

Abstract: Over the past year, a group of volunteer researchers collated and analyzed the laws and regulations of 77 different countries around the world as part of the International Astronomical Union's Centre for the Dark and Quiet Sky (specifically its Policy Hub, Work Package 2). The laws and regulations relating to dark and quiet skies are rapidly changing as awareness of the value of the night sky grows around the world, and some best practices and common elements are beginning to emerge. I will describe some of what we learned and provide a few case studies that could be used as exemplars and/or cautionary tales as other countries and advocates consider their next steps.

Principal Author/Presenter:

Name: **John Hearnshaw**

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Title: New Zealand needs national legislation for dark sky protection

Abstract: New Zealand needs national legislation for dark sky protection. This is because there are 61 district or city councils in the country, many of which are interested to bring in lighting controls within their district or city plans. Several communities in New Zealand already have bye-laws or lighting ordinances at local government level to curb light pollution, including in those dark sky places recognized by DarkSky International. At least two dozen communities aspire to become accredited dark sky places. However, local government is not well placed to duplicate local legislation in each district or city council, given that lighting technology is complex and changing rapidly. This would entail giving complex technical advice dozens of times over to every local body in the country. Instead, we need a single Lighting Control Act for the whole country, following the lead of France, Croatia and Chile which already have national laws for controlling light pollution. In 2023 I submitted a

petition to the New Zealand Parliament proposing that national legislation should be introduced.

Principal Author/Presenter:

Name: **Annette Lees**

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Title: After Dark: A cultural and natural history of night in Aotearoa

Abstract: Night time in Aotearoa has generated a trove of cultural and social history for New Zealanders including tales of war stealth, fireworks and ghosts, night fishing and swimming, navigation on ocean-voyaging waka and mountain walking in the dark. When this history is woven together with the ecology of darkness and natural history, a compelling case can be made for protecting our dark skies. Annette Lees shares these stories, discovered through the research and night walking she completed for her Ockham New Zealand Book Awards long-listed book, "After Dark: walking into the nights of Aotearoa."

Principal Author/Presenter:

Name: **Charlotte Harding**

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Title: Reflections on the journey - Wairarapa Dark Sky Reserve Association

Abstract: Looking back from the seed of an idea to what became a Regional project. The Wairarapa Dark Sky Reserve was certified in 2023. This talk will reflect on lessons learned through the process of gaining accreditation and how that is helping stage 2 of the project. We will update you on where we are now and close with aspirations and big-picture ideas for the future.

Session 5

Principal Author/Presenter:

Name: **Annika Jägerbrand**

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Title: Outdoor Lighting and Sustainability: Ecological Impacts and Future Directions

Abstract: Humans have long used outdoor lighting to enhance safety and enable an active lifestyle during dark hours. However, recent research has shown that light pollution can have serious effects on photo-sensitive species and ecosystems, gaining global attention. These effects raise important questions about how we can develop cities sustainably and improve our lighting technologies to reduce harm to the environment. This presentation will explore the challenges of dealing with light pollution and discuss ways to minimize its negative impacts.

Principal Author/Presenter:

Name: **Nalayini Davies**

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Title: Lessons learned from New Zealand and paths forward for NZ and other countries

Abstract: This will address New Zealand's progress in protecting its naturally endowed dark skies by moving to a countrywide approach and outline the practice of responsible astrotourism for economic development.

Principal Author/Presenter:

Name: **Laeticia Jacobs**

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Title: A strategy for the stars- A tourism response to sustainable development, community and preserving our Dark Night Sky

Abstract: Astro- tourism, a form of nature-based tourism, is a special interest niche market, where travellers explore the use of the unpolluted dark night skies, learn of the local celestial narratives and appreciate the scientific significance of the sky. In South Africa, the tourism industry is enhancing visitor experiences by seeking authentic tourism offerings, especially as South Africa is the host of the world's largest radio telescope, and also the largest optical telescope in the Southern Hemisphere. Therefore, government responded by leading the development of the National Astro-Tourism Strategy, which is governed by the Department of Tourism and the Department of Science and Innovation. With this strategic directive, the public sector is able to lobby support and funding to enhance astro-tourism related activities, lead campaigns to preserve the dark night sky and educating the tourism industry to use light responsibly, consider the environment and respecting indigenous cultures.

Principal Author/Presenter:

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Title: The Dark-Sky Movement in Taiwan: Preserving the Starry Night Across Diverse Landscapes and Cultures

Abstract: The Dark-Sky Movement in Taiwan, initiated by the stargazing community, has made significant strides in recent years, culminating in the designation of He-huan Mountain Dark Sky Park (HMDSP) as the third International Dark Sky Park in Asia in 2019. This achievement marks a critical milestone for the Chinese-speaking world in promoting dark sky conservation.

In 2022, the Taiwanese government invested substantial resources in the HMDSP project, aiming to foster local revitalization under the "Starry Mountain villages" initiative. This project involves collaboration among local associations, universities, government departments, external organizations, and the Taiwan Dark-Sky Association (TDA). The initiative not only seeks to revive Indigenous cultural astronomy and develop international astronomy tourism but also to raise public awareness of dark sky preservation and promote astronomy education in local schools. The establishment of a planetarium further enhances these efforts.

Founded in late 2020, the TDA became one of the International Dark-Sky Association's (IDA) Asian chapters, actively advancing dark sky conservation across Taiwan. Notably, the TDA advocated for Matsu's Daqiu Island to be recognized as the second International Dark Sky Park in Taiwan and played a pivotal role in the passage of Taiwan's first local lighting control act in Matsu. Based in Taipei, the TDA also spearheads educational initiatives, including therapeutic dark-sky experiences in Yangmingshan National Park, benefiting the general public and autistic communities.

In Eastern Taiwan, the Dark-Sky Movement has merged with ecological conservation, Austronesian culture, and tribal stargazing eco-tourism, particularly within the Amis tribe in Dulan, Taitung, which has safeguarded the starry sky for over seven years. Additionally, the recent establishment of the Taiwan Ocean Wayfinding Association (TOWA) in 2024 aims to revive traditional non-instrumental navigation culture among the Pacific Ocean through educational programs and reconnection with Oceania families, further expanding the scope of Taiwan's dark-sky and cultural conservation efforts.

Principal Author/Presenter:

Name: **Axiou Lin**

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Title: An alternative for dark sky in AI era

Abstract: AI Impacts everything, including dark sky initiative. My talk starts from the irreverence between star gazing preference and evolution of lighting, and try to respond with strategies by some local practice.

Session 6

Principal Author/Presenter:

Name: **Johan Eklöf**

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Title: Bats, insects, and light pollution - How we slowly kill the night

Abstract: There are more than 1,400 species of bats in the world, and they have been around for at least 55 million years. Yet, not a single bat species has evolved a diurnal life style. They are just as afraid of the light as humans are of the dark. Many species are caught in the ever-shrinking dark forests, stuck in lit-up buildings, and steer away from light glittering in

water. At the same time, the bats' food – insects – are drawn to light for reasons just recently revealed. Trying to orient themselves in a 3D-world, insects keep their backs to the light (which is normally the sky), why they are trapped in spirals towards streetlights, commercial screens, and flood lights. Some opportunistic bats make use of this smorgasbord, feeding off light-drunken moths, while others are waiting in vain for the sun to set. In Sweden, long-eared bats inhabiting church attics, have decreased by 50 percent over 30 years, making them one of the first mammals to appear on the red list due to light pollution. As all bats are nocturnal, and most of them are insectivores, they are just the perfect animals for studying the effects of light pollution on ecosystems. Saving the night for bats, will make the world a little bit better for plants, birds, insects, frogs, fish, turtles, marine invertebrates, and mammals, including humans. We were all evolved in a world where day was followed by night, and we all need darkness for a functioning circadian rhythm.

Principal Author/Presenter:

Name: **Alasdair Burns**

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Title: Five years of the Rakiura International Dark Sky Sanctuary

Abstract: Established in 2019, the Rakiura International Dark Sky Sanctuary has now been officially recognised by the International Dark Sky Association for five years. It has raised awareness of the pristine skies above New Zealand's third largest island, led to a change in visitor behaviour, and helped the island's abundant nocturnal wildlife. Here, on behalf of the Stewart Island Promotions Association, and as the owner of Twinkle Dark Sky Tours I'll be reporting back on what we've learned and how that might help make New Zealand a Dark Sky Nation.

Principal Author/Presenter:

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Institution: Tāhuna Glenorchy Dark Sky Sanctuary:

Title: Tāhuna Glenorchy Dark Sky Sanctuary Mīharo: Dark Sky Places, Wonder and the Creative Arts

Abstract: Long before astrophotography allowed us to capture the night sky through our lenses, people were expressing their wonder and knowledge learned from the stars through the arts. From Upper Paleolithic Cave Art, through to Van Gogh's Starry Night, the alchemy of sharing knowledge and uniquely expressing a sense of wonder seems a common thread in humanity's relationship to the night sky. In this presentation we discuss this phenomenon and share the ways in which the Tāhuna Glenorchy Dark Sky Sanctuary is focusing on the "Dark Arts" to encourage engagement with the arts and bring even more closely together the power of creativity to move people to connect with and care for biodiversity and the protection of Dark Sky places.

Principal Author/Presenter:

Name: The Hon **Matt Doocey**

Institution: New Zealand Minister of Tourism

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Title: New Zealand's Dark Sky Stewardship and the Value of Dark Skies for New Zealand Tourism

Abstract: The Minister will be discussing the value of dark sky tourism to New Zealand's tourism industry and how it can support the Government's ambitions for tourism growth with a focus on the off-peak and shoulder seasons. He will also cover the importance of New Zealand as a dark sky steward globally.

Principal Author/Presenter:

Name: **Nicky McArthur**

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Title: Kaikōura - a four year journey to DarkSky International Sanctuary Accreditation

Abstract: Kaikōura - a four year journey to DarkSky International Sanctuary Accreditation and why protection of our environment is so incredibly important from the mountains to the sea and everything in between, and why we should never stop learning.

Session 7

Principal Author/Presenter:

Name: **Bridgette Farnworth**

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Name: Dr Ellen Cieraad

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Title: The ecological impact of light at night in New Zealand: a decade of data

Abstract: The introduction of artificial light at night (ALAN) has rapidly transformed the nocturnal landscape in Aotearoa New Zealand. However, the ramifications of ALAN on indigenous flora and fauna remain largely unexplored. In the past decade, only 39 scholarly works have considered the ecological repercussions of nocturnal illumination. Collectively, the literature demonstrates that ALAN induces notable behavioural change across diverse taxa. Avian species (n = 17) have received the most attention in ALAN research, followed by mammals (n = 12), invertebrates (n = 9), fish (n = 4), and plants (n = 1), though significant gaps in our knowledge persist as major taxonomic groups, such as herpetofauna and marine mammals, have not yet been studied.

Evidently, ALAN disrupts animals' communication, navigation, and foraging, as well as

causing significant shifts organisms' behaviour by attracting or deterring them from illuminated habitats and altering the timing of their activities. Despite widespread use of nocturnal lighting, assessments of any long-term effects on population dynamics, community structure, and ecosystem function are absent.

This keynote presentation offers an overview of how native species in New Zealand adapt their behaviour in response to ALAN, with a focus on an iconic invertebrate species that is deterred by nocturnal light. It also highlights ALAN as an emerging ecological stressor in Aotearoa New Zealand and emphasises that further investigation to target species-specific data will be crucial for underpinning conservation efforts that aim to preserve nocturnal habitats.

Principal Author/Presenter:

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Airam Rodríguez, Departamento de Ecología Evolutiva, Museo Nacional de Ciencias Naturales (MNCN), CSIC, Madrid, Spain.

Title: Advances in the research on the interplay between seabird vision and artificial light

Abstract: When Procellariiform seabirds fledge, up to thousands of young birds gather and ground on urban lit area due to light pollution. These are high mortality events termed fallouts, which occur worldwide affecting over 50 seabird species. Hitherto we know that strong inland winds, new moon and harsh weather conditions (fog, rain), aggravate fallout. However, biological factors driving fallouts remain mostly unknown. Here we present a series of experiments and their results, conducted to study the relationship between seabirds and artificial light, focusing on the bird's visual system.

A previous study showed that Procellariiform chicks (*Hydrobates leucorhoa*) displayed delayed visual development at fledging. We hypothesized that the lack of light stimuli for burrow-nesting seabirds during development decreases visual ability at fledgling, acting as a main driver of fallout.

To test this hypothesis, we exposed growing Cory's shearwater chicks (*Calonectris borealis*, highly impacted Procellariiform species) registering their reaction to artificial light stimuli across their development. We found that increased exposure to artificial light improved the chick's environmental visual perception, and chicks that were exposed less times displayed more random behaviours. Our initial hypothesis was validated, i.e., the lack of light stimuli in burrow-nesting seabird chicks increases their vulnerability to light pollution, as fledgling

occurs without a fully functional visual system.

Secondly, we tested the behavioural responses of breeding adults and grounded fledglings, against distinct light treatments in a two-choice-maze. Both age groups clearly chose the maze area without light (versus white light) and the area with red light (versus blue). Our results indicate that seabirds are not directly attracted to light sources, i.e., a positive phototaxis. Why these birds gather in such high numbers in lit areas, remains unknown. In our third experiment we studied the post-release behaviour of rescued birds, their level of vulnerability to urban lights and possibility of re-grounding during the nights following release at sea. We analysed GPS tracks of rescued fledglings which showed that juveniles stay at sea, rafting close to shore, around their natal island for at least a week. Yet it is rare to recapture any back on land (all released birds are ringed so we can account for recaptures). Thus, the visual system of birds seems to quickly adapt to the lit environment (less than 24h after rescue and release), decreasing the vulnerability to light pollution considerably.

Principal Author/Presenter:

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Title: Improving light pollution management for wildlife

Abstract:

Principal Author/Presenter:

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Title: The World at Night: a new report from the International Union for Conservation of Nature

Abstract: The importance of unpolluted night skies to natural and cultural heritage is recognized by UNESCO and the International Union for Conservation. In 2007 UNESCO issued the La Palma Declaration in Defence of the Night Sky and the Right to Starlight. In response, UNESCO and the IAU established the thematic Initiative on Astronomy and World Heritage. In 2009 the IUCN followed suit by establishing within its World Commission on Protected Areas a Dark Skies Advisory Group (DSAG) to explore the links between dark skies and ecological integrity and provide appropriate advice. At its quadrennial World Conservation Congress in 2012 and 2020 the IUCN passed resolutions calling for dark sky restoration and protection and related public engagement. DSAG responded by producing an

overview of the current science and best practices, primarily but not exclusively for a nature conservation audience. It was published this year and is available online for free from [<https://portals.iucn.org/library/node/51414>].

The report describes the value of dark skies for natural and cultural heritage, its impacts on these as well as human health, safety and security, energy efficiency, astronomy and the public enjoyment of the night sky, and traditional and cultural practices. It gives an overview of certified dark sky places around the world. Sixteen such places are used as examples of achievements and best practices and a variety of contexts, for protected places to outreach sites to urban and rural communities. It presents guidelines for outdoor lighting and public engagement, and presents an overview of related laws and policies, both as of the time of submission for publication, 2022. In addition there are appendices on: illumination levels and night vision; the spectra of common lamp types; recommended luminaire types and mounting heights; signage; scales and units for measuring light pollution; lighting recommendations for low ecological impact; measuring equipment and protocols; and aspirational skyglow values for dark sky places.

Principal Author/Presenter:

Name: **Ping Lei**

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Title: Dancing Lights: The Role of Firefly Conservation in Reducing Light Pollution

Abstract: Light pollution disrupts ecosystems and diminishes firefly populations, which rely on darkness to thrive. My talk explores how restoring firefly habitats can serve as a natural solution to reducing light pollution. By creating darker, moisture-rich environments with suitable vegetation, fireflies can flourish, and light pollution can be minimized, benefiting other nocturnal wildlife and enhancing starlight visibility. I will share my restoration projects and discuss different methods to reduce artificial lighting. This approach highlights the synergy between firefly conservation and starlight preservation, inspiring communities to adopt sustainable practices that protect both these luminous insects and the beauty of the night sky.

Session 8

Principal Author/Presenter:

Name: **Steve Chadwick**

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Title: Beauty in the Stars: a journey through the cosmos

Abstract: This talk and video will display some of my deep-field images of beautiful objects in the Milky Way that I have recorded in recent years.

Principal Author/Presenter:

Name: **Jeff Dai**

Institution: Dark Sky Beijing Chapter

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Title: Capture the Wonder of the sky

Abstract: The wonder of the sky captured by astrophotographers can leave one in awe, but they can also be important to dark sky protection and astronomy tourism. If you're interested in capturing stunning images of the night sky with your cameras and smartphone, you've come to the right place. The talk will provide the techniques and skills to capture the Milky way galaxy, startrails, aurora, moon, stunning timelapse, and take your astrophotography to the next level.

Principal Author/Presenter:

Name: **Hidehiko Agata**

Institution: National Astronomical Observatory of Japan

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Title: The emotion “Awe” and the effect of the starry sky

Abstract: Insights from neuroscience and psychology suggest that experiences evoking awe and wonder, such as stargazing, may elicit prosocial behavior.

Starry sky posters were distributed to hospitals. Notable results include 60% of respondents reporting feeling healed upon viewing the starry sky poster and 58% expressing a desire to witness the actual starry sky (n=279). Through this research, we acknowledge that astro-tourism has the potential to not only promote healing but also foster prosocial behavior through the cultivation of awe-inspiring emotions.

Principal Author/Presenter:

Name: **Amie Young**

Institution: Great South, Invercargill

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Title: Dark Skies in Murihiku Southland

Abstract: Amie Young of Great South will share insights into Murihiku Southland's dark skies journey. The Regional Development Agency supported the Stewart Island Rakiura community to gain Dark Sky Sanctuary accreditation in 2019 and are also working with the Department of Conservation and the Fiordland community to achieve the same designation for Fiordland National Park.

Principal Author/Presenter:

Name: **Louise Beer**

Institution: None

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Title: The Transparency of Night

Abstract: My talk will be based on my chapter, The Transparency of Night, as per below. I will prerecord the talk and join live from the UK for a Q&A if there is the opportunity:

"As light pollution increases around the world, humanity is losing a symbolic visual connection to the cosmos, shared by our ancestors throughout history. The author examines how living under the dark skies of Aotearoa, New Zealand, has influenced her artistic and curatorial practice and how her artwork can invite the audience to explore their own changing relationship with the night. Through the discussion of five artistic projects, this chapter explores how living under dark skies, or light-polluted skies, can change our perception of grief, the climate crisis, and Earth's deep-time history and future. Each of the projects has started with a fundamental connection to the night sky and reflects the author's changing understanding of life, death, darkness, and light."

Session 9

Principal Author/Presenter:

Name: **Mario Motta**, MD, FACC

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Title: medical effects of light pollution

Abstract: LED lighting is an important energy saving choice, but it is important to take into consideration human and environmental health concerns when choosing LED's. Some LED lighting fixtures produce excess blue emission, which have adverse health effects. Excess blue light at night causes disruption of circadian rhythmicity through suppression of melatonin production by the pineal gland. Melatonin has been shown to be an important adjuvant to the human immune system, and thus when suppressed has detrimental human health effects. Many white LED street lights have a spectrum that contains a strong spike in the blue wavelength, which is most effective at suppressing melatonin during the night. There is now voluminous data showing a higher risk of hormonally linked cancers with melatonin suppression, such as breast and prostate cancers.

Also, improperly designed lighting fixtures can result in glare, and create a road hazard condition. This can be greatly mitigated by proper design, shielding and installation so that no light shines above 80 degrees from the horizontal. The visual hazard by these very intense point sources is magnified by higher color temperature LEDs because blue light scatters more in the human eye, leading to increased disability glare and has serious implications for night-time driving visibility.

Lighting engineers and manufacturers should consider human health and environmental effects when designing and producing LED's. Low Blue LED's that are properly shielded are now readily available, and should be preferentially chosen. I will discuss why the American Medical Association recommends 3000K or lower CCT in nighttime lighting installations
Mario Motta, MD, FACC

Principal Author/Presenter:
Name: **Bryan Boulanger**
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Title: Restoring Natural Nightscapes – Lessons Learned from Supporting Partner Initiatives over the Past 10 Years.

Abstract: Restoring natural nightscapes can be a complex challenge. Challenges include overcoming administrative factors, supporting stakeholder involvement, managing budgetary limitations, understanding existing artificial lighting, addressing non-compliant lighting, patience for realizing change, and resisting increasing pressures for development. Over the past 10 years the presenter has worked to support 40+ partners seeking to better understand and restore their natural nightscapes. Along the way 14 of these partners went on to become Dark Sky Parks or Communities. This presentation will share advice for Dark Sky advocates, land managers, and other decision makers. Best practices for establishing goals for nightscape restoration, completing GIS tied inventories of existing artificial lighting, and supporting decision making will be shared.

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Title: Xichong Dark Sky Community – the experience and achievements

Abstract: With the establishment of China's first International Dark Sky Community in Shenzhen, Xichong Dark Sky Community has developed some regulations on the management of lighting environment, including a special plan for urban lighting in Shenzhen and some local standard of Shenzhen. These regulations can effectively improve the lighting environment, meet the needs of meteorological and astronomical research and create standards for peers, meet the cultural needs of citizens for astronomical observation and provide them with a good stargazing sanctuary. These also stimulate the economy and create many job opportunity for local citizens. I will share experiences and achievements of Xichong.

Principal Author/Presenter:
Name: **Mohammad Saleh Timar**
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Title: Charting Astro-Tourism Trails Across Iran's Desert Belt: Stargazing Under Majestic Desert Skies

Abstract: opportunities for adventure, astronomy, and nature experiences. Through more than ten expeditions to the Lut Desert, Central Desert, and Rigestan Desert, we designed innovative trails that seamlessly combine these elements. We are excited to introduce these trails in our upcoming tours for Autumn 2024 and Winter 2025, which we believe will transform adventurous travel in Iran's deserts.

Additionally, we conducted SQM measurements to identify the darkest skies in the region, and our future tours will support ongoing sky quality assessments. We view these tours not only as an exploration of stunning landscapes but also as a valuable opportunity to raise community awareness about light pollution and promote the use of environmentally friendly lighting for camping.

Session 10

Principal Author/Presenter:

Name: **Philippa Gander** FRSNZ, ONZM

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Title: Light Pollution and Human Health

Abstract: This presentation will explore how your light-sensitive circadian body clock modifies the functioning of your brain and body across the day/night cycle and programmes you for sleeping at night, ideally for about a third of your life. All cell-based life forms on Earth have circadian clock genes, but we are unique in our determination to override the pattern of living dictated by ours. The presentation will examine how our race to 24/7 living, with its associated increase in artificial light at night, is having major impacts on our health and well-being, as well as on the complex ecosystems that sustain us.

Principal Author/Presenter:

Name: **Alexander Tups**

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Title: The importance of maintaining a healthy circadian rhythm for metabolic health, immunity and behaviour

Abstract: Most living organisms rely on a synchronization between daily environmental alterations and their biologic processes for their survival. This is facilitated by a biological clock, located in the brain, that is typically entrained to the solar light/dark cycle.

Rapidly growing evidence suggests that disrupting this circadian rhythm, which is brought about by light exposure at the wrong time may increase the risk for metabolic disease, depression, sleep disorders and dementia. This can occur due to our modern lifestyle, which may include shift-work (classified as a carcinogen in Denmark), frequent jet lag, social jet lag (the difference in the time we sleep during work and work-free days), or exposure to bright artificial light at the wrong time. In our laboratory, we use different well-established animal models, mice and zebrafish, that share many similarities to humans to study effects of

disruptions to the circadian rhythm on metabolic disease, immunity and behaviour.

We and others established that neuroinflammation is a leading cause of the development of metabolic disease. Subsequently, we established that disruptions of the circadian rhythm, by light exposure at the wrong time, can lead to impairments in metabolic health. The immune system plays a key role in neuroinflammation, and we have now established that the biological clock plays a key role in immunity in zebrafish. Genetic modification of key components of the biological clock led to a reduced ability to fight infection, higher mortality and disruptions in behaviour. These effects also occurred by exposing zebrafish to artificial light at the wrong time.

Blue light is a key component in the visual light spectrum that is proposed to significantly influence circadian rhythm regulation. Exposure to artificial blue light is increasing rapidly. We hypothesised that exposure to blue light may be particularly detrimental in disturbing natural behaviour in zebrafish and may potentially induce neuroinflammation. Utilising a novel automated observation chamber, we measured the effects of blue, in comparison to red, green and white light on behaviour and neuroinflammation. Indeed, blue light was particularly detrimental as it severely impacted behaviour. compared with light of different colour. Whether blue light can also induce neuro-inflammation is an ongoing investigation.

By understanding the behavioural and physiological impacts of artificial light exposure at the wrong time, our research contributes to our knowledge of impacts of circadian rhythm disruption on metabolic health and immunity, potentially informing guidelines for artificial light usage and its impact on biological systems.

Principal Author/Presenter:

Name: **Luca Devescovi**

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Title: From Akaroa to the Stars: Engaging the Public with Astronomy and Dark Sky Preservation

Abstract: This presentation explores the unique stargazing experience in Akaroa, and the critical role of public engagement in preserving dark skies. At Akaroa Stargazing, we are fortunate to have a location that offers stunning views of the night sky, accentuated by the natural beauty of the surrounding landscape. However, the glow of Christchurch city to the North-West reminds us of the ever-present threat of light pollution and underscores the importance of our efforts to protect these pristine skies.

Our stargazing tours begin with a discussion on light pollution and actionable steps individuals can take to combat it. This education is vital not only for enhancing the stargazing experience but also for fostering a culture of conservation among our visitors. By raising awareness of light pollution, we aim to inspire our guests to become advocates for dark sky preservation in their communities.

The coastal environment in Akaroa, while beautiful, presents unique challenges for stargazing. Variable weather conditions, sudden cloud cover, and atmospheric turbulence from ocean breezes can impact visibility. Despite these challenges, we have learned to adapt, ensuring that our guests enjoy the best possible views of celestial wonders, from the Milky

Way to distant deep sky objects.

Our outreach extends beyond guided tours. We engage with local schools, sharing knowledge about astronomy and the impacts of light pollution. These interactions have been particularly rewarding, with students even taking the initiative to write to the Mayor of Christchurch, urging a reduction in unnecessary lighting. Although their efforts have not yet yielded the desired response, these experiences highlight the power of education and community involvement in driving change.

Looking forward, we aim to deepen our collaboration with local authorities and explore initiatives like obtaining 'Dark Sky' status for Akaroa. Such recognition would not only enhance our stargazing offerings but also contribute to a broader movement to preserve our night skies for future generations.

This talk will illustrate the importance of combining public engagement with environmental stewardship, showcasing how a small community can play a significant role in the global effort to combat light pollution.

Principal Author/Presenter:

Name: **Kaye Paardekooper**

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Title: Astro tourism, how to develop a world class sustainable astro tourism venture

Abstract: Astro tourism, is an emerging niche in the travel industry and has grown significantly in recent years as people seek immersive experiences in stargazing and astronomical observations. This form of tourism not only offers unique opportunities to explore the wonders of the night sky but also plays a crucial role in raising awareness about the need to reduce light pollution. The benefits of dark skies on the environment and also human health and wellbeing are well documented. Astro tourism can serve as a powerful tool in advocating for the preservation of dark skies, highlighting the importance of minimising light pollution.

Astro tourism destinations are often located in remote, low-light areas such as our own Mackenzie Region where the skies are accredited by IDA as a Reserve unspoiled by light pollution. Here we have unparalleled views of the Milky Way, meteor showers, aurora, and other astronomical phenomena. Some tourists are attracted to our region specifically to view our dark skies and stargaze, others come for differing reasons. However, all those venturing here develop a deeper appreciation for the wonderment and beauty of natural night sky. Visitors, especially those from highly populated brightly lit areas are over-awed and an astro tourism venture can foster awareness of the impacts of artificial lighting on the night environment, the necessity of protecting dark-skies, and telling the stories of why a dark sky is so vital to our world and the creatures that inhabit it.

However, astro tourism without boundaries can devastate dark sky areas with effects such as increased lighting or light spill, more people, or crowded astrophotography sites all having an incremental impact on light pollution and the visitor experience. Creating a sustainable astro tourism experience is beneficial economically, and this needs to go hand in hand with a commitment to implement measures such as lighting practices and regulations that

sustainably protect darkness, benefit local ecosystems, wildlife, and human health and preserve the wonderment of the stargazing experience.

Mt Cook Lakeside Retreat, began offering stargazing and astrophotography from the purpose built Pukaki Cellar Observatory in 2015, with the intention of creating a sustainable stargazing experience for mostly international guests. ‘The Retreat’s aim was to provide a rich experience that wove astronomy, local storytelling and light pollution effects into a compelling ‘once in a lifetime’ experience firmly rooted in a New Zealand High Country context. We wanted our guests to be inspired and to take time to look up in appreciation of the world that we live in. For us, a sustainable astro-tourism venture needed solid foundations which we will describe in this presentation.’ In this presentation, we will tell the story of how we have sustainably come from an acorn of an idea to having the Retreat and our Billion Star Dining product recognised by TIME as one of the World’s 100 Greatest Places.

Principal Author/Presenter:

Name: **Aryush Aravind**

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Title: Dark Skies For All

Abstract: Light pollution, an often overlooked environmental issue, has far-reaching effects on ecosystems and human health. Excessive or misdirected artificial light disrupts natural cycles and contributes to habitat loss and sleep disorders. Understanding and mitigating its effects has become a central focus for our advocacy and outreach efforts. The primary aim of our initiative is to raise awareness about light pollution's detrimental impacts and promote strategies for its reduction through community education.

Over the past six months, my team and I have conducted information sessions in local schools, colleges, and science centers, where we shared insights on how light pollution impacts our environment and what steps can be taken to mitigate it. Our goal for the current school year is to expand these efforts by establishing light pollution awareness clubs in other high schools and middle schools across Orange County. Our efforts also include practical actions within our community, such as measuring street light intensity, logging non-compliant light poles, and developing a report for the city council. This report, based on six months of data, will advocate for enforcing light pollution regulations.

In addition to educational efforts, our team is also working to promote the use of DarkSky-approved lighting fixtures designed to minimize light pollution. Currently, limited retailers carry these products, highlighting the need for more retailers to join this cause. We are actively reaching out to retailers in Southern California to sign new retailers to carry DarkSky-approved lighting fixtures by the end of the school year. This effort is complemented by our initiative to engage with lighting manufacturers. A recent survey revealed that less than 10% of outdoor light sources are in the warm color range (3000K or less) and less disruptive to the environment. We aim to work with these manufacturers to increase the availability of warm color light sources.

Looking ahead, we are launching FLiP@Home, a new project aimed at reducing indoor light pollution. As a part of this initiative, we are developing a concept for an indoor household switch that adjusts lighting based on ambient conditions and activity in progress. Through these combined efforts, we aim to foster greater community engagement and drive tangible

improvements in light pollution management. Our overarching mission is to reduce light pollution and its harmful effects, promoting a healthier environment for people and wildlife.

Session 11

Principal Author/Presenter:

Name: **Connie Walker**

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Title: Protecting observatory sites from the growing satellite constellation interference - the IAU CPS

Abstract: The deployment of communication satellite constellations in Low Earth Orbit (LEO) may represent a valuable step in improving world connectivity. However, sun-reflected luminosity and radio-frequency emissions from a large number of satellites can have a serious impact on astronomical observations, as well as on the pristine appearance of the night sky. Bright streaks impact optical/infrared observations and create the potential for space debris to scatter sunlight and increase the diffuse night sky brightness. Operators offering direct-to-cell services require very large antennas, which can be among the brightest objects in the night sky. Recently, various strategies for co-existence in terms of optical astronomy have been developed. Better models and data for satellite brightness being developed are key to enabling mitigation, active avoidance, or use in compliance checks.

Future observations of commercial LEO satellites will determine, for instance, whether some coatings and Bragg mirrors on reflective surfaces of Starlink satellites will help. For spectroscopy, better modeling and understanding of satellite spectra will enable the emission from satellites to be calibrated out of astronomical data. Autonomous imagers on large spectroscopic facilities can help identify when an exposure was contaminated. For observatories, there are software solutions for streak detection and elimination that may help.

That said, no regulations currently extend radio-quiet zone protections against downlinks from space. Since all transmitters above the horizon are detectable in the radio, there is a steady loss of certain frequency ranges to opportunistic observations. Further, unshielded electronics and motors create low-frequency transmissions that are detectable from the ground. To address these issues, the IAU's Centre for the Protection of the Dark and Quiet Sky against Satellite Constellation Interference (IAU CPS)(cps.iau.org) is taking multiple approaches to mitigate negative impacts. At least 15 operators meet under their auspices to share best practices and understand astronomical concerns. Observing campaigns are organized. Predictive software for position and brightness of satellites impacting planned observations is well into development. Educational videos about satellite constellations are available, and ongoing efforts are underway to engage with impacted indigenous groups. CPS-affiliated policy and space law experts have developed recommendations for ultimately turning best practices into a model regulatory framework. Because of the IAU raising awareness, UN COPUOS is now adopting a five-year agenda item to consider astronomy and satellite constellations and the ITU-R is taking up some key issues of protection. The IAU is leveraging its truly international constituency to address this urgent global issue.

Principal Author/Presenter:
Name: **Michele Bannister**
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Title: Satellite impacts on southern skies: a journey in observations and policy

Abstract: The impact of satellites on Southern skies became rapidly apparent from 2021 onwards, as the pace of launches for satellite megaconstellations began. I will review the journey of observation and policy that has taken place to the present, from both an observational astronomer's perspective as Deputy Director of Mt John Observatory and close involvement in Rubin Observatory's upcoming Legacy Survey of Space and Time (LSST), and from direct involvement in domestic policy development over that time. With launches accelerating worldwide for creation of satellite megaconstellations, we are on the verge of skies that are webbed in a continuously moving net of light.

Principal Author/Presenter:
Name: **Karen Pollard**
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Title: Astrophysics Research from an International Dark Sky Reserve

Abstract: At the heart of the Aoraki Mackenzie International Dark Sky Reserve lies New Zealand's premier optical research observatory - the University of Canterbury Mt John Observatory. The Observatory has been a crucial facility for observational astronomy and astrophysics research in New Zealand for over 50 years. Although small in size by world standards, our Observatory has many unique advantages, enabling our researchers to undertake cutting-edge research in niche research areas.

In this talk, I will briefly review some of the key features that make the UC Mt John Observatory unique. I will describe a number of recent research projects being undertaken by staff and students at the Observatory and present highlights from recent discoveries and publications.

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Title: Light pollution and radiation distance in urban ecological space during Guangzhou international light festival

Abstract: Abstract: The economic and cultural value of light festivals is highly regarded, but the light pollution has not been fully recognized. This paper takes the Guangzhou

International Light Festival as a case study to quantify light pollution caused by light festival. By monitoring changes in night sky brightness before and after the light festival, and analyzing the variation in brightness at different observation points, we quantitatively assess the light pollution caused by the festival and its impact distance. The results show that the light festival significantly increases night sky brightness, including persistent and instantaneous changes. Before and after the light festival, the average night sky brightness within 16 km of the main venue increased by 0.32 mag/arcsec², with a variation range of 1.6-2.7%. The largest variation was observed at the northern gate of Haizhu Wetland Phase I, 3.5 km from the main venue. On the festival opening ceremony, the greatest instantaneous change in night sky brightness was at Haizhu Wetland Phase II, 6 km away, with a variation of 0.57 mag/arcsec² and a fluctuation range of 3.5%. Additionally, comparing the fluctuations in night sky brightness at different observation points during the festival, we found that the Guangzhou International Light Festival significantly impacts night sky brightness within a 6-7 km range, with the effect being particularly pronounced in the Haizhu Wetland Park. We hope the findings will promote a better understanding of the negative impacts of large-scale light shows on ecological health, leading to measures such as rational planning of light source layouts and controlling lighting directions to reduce their impact on the natural ecological environment.

Principal Author/Presenter:

Name: **Gareth Davies**

Institution: DarkSky International and Dark Sky Network New Zealand, Auckland, NZ

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Title: Effective path to International Dark Sky Places certification

Abstract: This talk discusses the various elements involved in DarkSky International's International Dark Sky Place (IDSP) certification journey and the tools, resources and support available to make this journey efficiently and quickly, including support from me as DarkSky International's Regional Co-ordinator for Oceania.

Session 12

Principal Author/Presenter:

Name: **Carol Redford**

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Title: Astrotourism Towns: Leveraging Dark Sky Tourism and Total Solar Eclipses to Reduce Light Pollution

Abstract: A private and Local Government partnership is harnessing Western Australia's world-class dark night sky as an asset for economic, social and environmental outcomes.

The Astrotourism Towns Project is creating a stargazing trail through WA's remote, regional communities with the aim to increase overnight visitation, grow jobs, businesses and the local tourism economy. At the same time, the partnership is facilitating the protection of the dark night sky from light pollution by advocating for dark sky friendlier street lighting options for Local Government.

As WA transitions to LED street lighting, there is an opportune moment in time to protect the night sky. Three total solar eclipses are visible from WA over the next 15 years, more than anywhere else on the planet. The global spotlight this brings strengthens the promotion of dark sky tourism, improved lighting management and the reduction of light pollution.

Principal Author/Presenter:

Name: **Darius Singh**

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Title: Gaia (Earth) Estate - Fiji's 1st Dark Sky Sanctuary

Abstract: In an ever-increasing population, pressure and pollution across all cities in the world, one place still exists that is virtually untouched. An island that is half the size of the main land, yet only houses about 10% of the country's population, versus 90% on the main land. This land is Gaia (Earth) Estate in Vanua Levu, Fiji, in the heart of the Pacific Ocean.

The Gaia (Earth) initiative was established by Dr Darius Singh and Nikeeta Singh to reintroduce mother earth, nature, biomimicry thinking and biophilic design back into our modern and fast paced lives. For the past 15 years, they created the Gaia (Earth) Education Philosophy®, published/presented this across eight countries and built a handful of schools to bridge the theory into real life. Their schools became the most award winning education group in New Zealand, called Chrysalis Group.

This project seeks to repeat past successes in promoting Gaia / Earth / Mother Nature. This time the attention is turning sky high to establish Fiji's first Dark Sky Sanctuary. The problem is that there is a race against time before desperation, poverty, unemployment, lack of education sets in to spiral the local economy and 112 villages in the Macuata Region of Vanua Levu into further complex challenges of the developing country.

Our project proposes to build a "super-magnet" around the region's natural resources to attract tourism to the region in the form of 1) Agri-tourism (i.e. high value / high margin crops), 2) Eco-tourism (i.e. solar PV plants, rainwater harvesting irrigation systems) and 3) "Astro-Tourism" (i.e. Dark Sky sanctuary, cultural connections with local Fijian people).

Our location is hidden in a 250 acre rainforest bordered by 5km (>3miles) of the deepest river in Fiji (Dreketi River – a marine sanctuary declared in 2023). Our vision is that through the emergence of Agri / Eco / Astro Tourism, nearby villages, women and young people will finally have a super magnet to attract social benefits (through education), economic benefits (through tourism, microbusinesses, cultural markets) and environmental benefits (through a protection order over the land ensuring biodiversity). All three benefits will interlink to create a meaningful sustainable solution for the presently diminishing village population, education outcomes, and economic resilience of the society.

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Institution: Kimino Town Misato Astronomical Observatory
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Title: Revisiting the relation between the establishment of public astronomical observatory and national policy in Japan

Abstract: In recent years, astro-tourism has started to attract an increasing number of tourists, both internationally and in Japan. In Japan, astronomy-related facilities such as public astronomical observatories and planetariums have played a central role in astrotourism. Public Astronomical observatories are facilities that have been established not as research facilities for observational astronomy, but for the purpose of providing access to the general citizen. There are over 350 public astronomical observatories in Japan. Japanese public observatories have two aspects: one is as social education facilities to promote astronomy education including enlightenment of light pollution, and the other is as tourism resource as core facilities for astrotourism. The first public observatory in Japan was Kurashiki Astronomical Observatory, established in 1926 in Okayama Prefecture. After that, the number of public astronomical observatories increased rapidly in the 1980s and 1990s. The number was only 30 in 1970, 186 in 1990 and 354 in 2000. In addition, public astronomical observatories established in the 1980s and 1990s tended to install large-aperture telescopes, with more than 10 facilities having telescopes with an aperture of more than 100 cm. The purpose of this presentation is to examine the background to the rapid increase in the number of observatories established in the 1980s and 1990s, particularly in the context of national environmental and development policies.

Principal Author/Presenter:
Name: **Warren Hurley**
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Title: A new astronomy outreach tool

Abstract: Presenting a novel - but somehow obvious - tool for helping residents and visitors to appreciate the dark night sky in communities across Aotearoa.

Principal Author/Presenter:
Name: **Lydia Stoddart**
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Title: The Aoraki Mackenzie Dark Sky Story

Abstract: The Mackenzie Region is famous for its starry night skies and broad range of astro-tourism experiences. In 2012 they were the first in the Southern Hemisphere to obtain Dark Sky Reserve status, and today the region is home to more than 8 stargazing operators, as well as a range of astrophotography experiences, events, accommodation offerings and experiences that leverage the stars. Lydia will share the Aoraki Mackenzie International Dark Sky Reserve's journey, the ingredients to its success as a tourism drawcard, and some of their key learnings.

Posters

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Title: Assessing the use of environmental lighting zones for the protection of aquatic nature conservation areas

Abstract: Anthropogenic light can have adverse effects on species and ecosystems, effects that are numerous and challenging to anticipate due to their high variability and complexity. In this study our objective was to investigate the feasibility of utilising environmental lighting zones for the management of aquatic Natura 2000 conservation areas. The aim of the Natura 2000 network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. Maintaining a favourable conservation status and sustainable management of these habitats is of utmost importance, necessitating the avoidance of negative impacts of human activities, including anthropogenic light. Our preliminary findings indicate that employing a relatively high number of environmental lighting zones intervals is essential for effective implementation of mitigation measures. This approach facilitates the identification of protected areas experiencing the highest levels of light emissions, aiding in targeted conservation efforts.

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Title: Origins and ecological relevance of international obtrusive light thresholds

Abstract: Light pollution disrupts ecosystems and species behavior, yet current international obtrusive light thresholds predominantly target human discomfort, with limited ecological consideration. This presentation examines the origins of these thresholds and their inadequacies in addressing ecological impacts. It emphasizes the need for updated limits that reflect modern light sources and species-specific sensitivities, such as those affecting bats, birds, and insects. New environmental zones and ecologically-driven thresholds are essential for mitigating artificial light's adverse effects on biodiversity and ensuring more effective conservation strategies. Incorporating these updates into international standards is critical for improved environmental protection.

Principal Author/Presenter:

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Title: Analysis of Light Pollution Characteristics in Marine Nature Reserves of the Pearl River Delta Region

Abstract: Light pollution is the fourth largest type of pollution and poses a significant threat to marine ecosystems. This study quantitatively analyzed the evolution characteristics and spatial distribution patterns of light pollution in marine nature reserves in the Pearl River Delta region using satellite remote sensing imagery. The findings reveal that the nocturnal light environment in marine nature reserves of the Pearl River Delta significantly deteriorated from 2012 to 2023, with the total light value increasing from 9566.2 to 23701.3 nW/cm²/sr, and the mean value rising from 0.8 to 1.9 nW/cm²/sr. Scenic spots and wetland parks experienced the highest levels of light pollution. Spatially, marine nature reserves closer to the mainland suffered more severe light pollution, and the edges of these reserves were more affected than their interiors. Among different cities, Shenzhen and Dongguan had the highest levels of light pollution in their marine nature reserves, while Jiangmen and Huizhou had the lowest. The spatial distribution pattern of light pollution demonstrates a close relationship between the nocturnal light environment of nature reserves and the intensity of coastal development. These research findings will provide a scientific basis for optimizing the nocturnal light environment of marine nature reserves from an integrated land-sea perspective.

Principal Author/Presenter:

Name: **Warren Hurley**

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Title: Experiencing awe

Abstract: Awe is the emotion we experience when we encounter vast mysteries that we don't understand. In awe we understand that we are part of many things that are much larger than the self. When we experience awe, regions of the brain that are associated with the excesses of the ego, including self-criticism, anxiety and even depression quieten down.

Principal Author/Presenter:

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Title: Piercing the dark sky cloak - the expansion of light pollution in Aotearoa New Zealand

Abstract: Using satellite data to quantify spatiotemporal trends of ALAN in Aotearoa New Zealand between 2012–2021, we show that the extent and brightness of light emissions into the night sky are growing rapidly. Although while the vast majority (95.2%) of the country had no direct emissions of ALAN, in this decade, the lit surface area increased by 37.4% (from 3.0% to 4.2%) to > 11 000 km². The illuminated surface area in Aotearoa New Zealand is growing faster than the expansion of the country's builtup area, and at 3.2% increase per annum between 2012–2021 is also faster than the global average (2.2% per annum between 2012–2016). A total of 4 694 km² of our country experienced increased brightness (median increase of 87%) over the decade. In contrast, 886 km² became less bright (median decrease 33%), mainly in urban centres where absolute brightness remains high. Our estimated increases in ALAN extent and brightness are underestimates as satellite imagery does not capture sky glow, nor the full extent of the light spectrum emitted by increasingly common light emitting diodes. At ALAN's current rate of increase, Aotearoa New Zealand is in danger of losing its cloak of darkness, resulting in increased negative environmental and social impacts.

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Title: The effect of light pollution on the functioning of wild plants

Abstract: Anthropogenic light at night (ALAN) is rapidly expanding, affecting ecosystems similarly to other environmental pressures. However, its effects and particularly the impact of different light colors, on plant physiology are less well understood. This study investigates how different colors of artificial street lighting influence the morphology and nighttime assimilation rates of two wild plant species, *Hypochaeris radicata* and *Rumex acetosa*. Using a semi-natural mesocosm setting, plants were exposed to red, green, and white streetlights, with a dark control, over an eight-week period. Results indicate that red light significantly increased leaf length and petiole elongation compared to other treatments. Nighttime transpiration and stomatal conductance also increased under red and white light. These findings highlight that ALAN, particularly red and white light, can disrupt plant growth and physiological processes, potentially affecting overall ecosystem dynamics. This study underscores the interplay between light pollution and plant health, emphasizing the complex effects of different light colors on primary producers and their broader ecological implications.

Principal Author/Presenter:

Name: **Andy Davey**

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Title: Unique Night Skies of Otago

Abstract: Central Otago, renowned for its stunning landscapes, offers one of the clearest and most pristine night skies in the Southern Hemisphere. This poster explores the region's unique astronomical features, including minimal light pollution, regular Aurora, and diverse weather patterns that contribute to unparalleled stargazing opportunities.

Winterstellar Charitable Trust combines scientific insights with astro-photography and community engagement, and advocates for the preservation of Central Otago's night sky as a vital natural resource for tourism, education, and cultural identity.

On 22nd July 2028 a Total Solar Eclipse will pass directly over Central Otago. It is our aim to have International Dark Sky Reserve recognition and protection for large areas of the Central Otago in place before this special event.

Principal Author/Presenter:

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Institution: Wai-iti Dark Sky Park -web site manager

Title: The Wai-iti Dark Sky Park

Abstract: These three posters (total 900 mm X 600mm) Are a replica in miniature of the signage at the Dark Sky Park at Wai-iti, Tasman.

The first poster outlines the history of the area, 1856 to 2020.

The second covers the details regarding the Dark Sky Park.

The third Why are dark skies important, and practical ways to reduce light pollution.