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**Re: Initial Input and Ideas for
5th Session of the United Nations Environment Assembly**

Dear UN Environment Programme Secretariat and
Norwegian Ministry of Climate and Environment:

By this letter, I submit my¹ input and ideas for the 5th Session of the United Nations Environment Assembly (“UNEA-5”) in response to specific questions identified in Minister Rotevatn’s letter inviting comment dated 24 April 2020 (“Invitation Letter”).² In so doing, I focus on the need to clearly include the night sky within the Earth’s environment and light pollution – both terrestrial and celestial – as an adverse environmental impact. Though the principles proposed below encompass these concepts broadly, I am particularly focused on the adverse effects of mega-constellation satellite systems on the night sky.

Executive Summary

The Invitation Letter sought input on the “most important elements or key messages” to include in the ministerial declaration and how the Environment Assembly could make a significant contribution on a global scale to UNEA-5’s theme, *Strengthening Actions for Nature to Achieve Sustainable Development Goals*. In my interpretation of both the

¹ This letter conveys my own personal views and those of Mudd Law. I do not contend to speak for anyone else. That being said, I offer my personal views for the betterment of those who share the world with me and the generations of those to follow.

² I very much appreciated receiving a copy of Minister Rotevatn’s letter and invitation to submit my answers by email from Jenny Hovland Johanson.

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questions and the theme, the unblemished night sky must be recognized as a critical component of Earth's environment necessarily requiring corollary efforts to protect it.

Thus, the ministers should clearly articulate that Earth's natural environment includes the unblemished night sky and its visible elements. Moreover, the ministers could, therefore, recognize that conduct negatively affecting the night sky necessarily imposes an adverse environmental impact. Thus, such conduct should be minimized (if not prohibited), and mitigation efforts should be implemented to protect our night sky. Together, the formal recognition of these three night sky principles (hereinafter, "Night Sky Principles") will significantly contribute to Sustainable Development Goals on a global scale by providing the means by which member countries and *their individual citizens* can advocate – on a local and international level – for sound policies that protect the night sky – and our environment.

This can occur through existing law containing environmental provisions or the adoption of new laws that encompass the night sky within their environmental scope. The Environment Assembly's impact could thereafter be observed as extending from local development of light sensitive city planning to the broader development, commercialization, exploration, and population of international space.

Night Sky and the Environment

The Night Sky represents a critical component of our environment. Yet, given its distance, we often overlook its significance when contemplating the environment. This occurs on a local, national, and international level. Given the scope of this letter and the questions asked, I focus on the international level.³ By doing so, I hope that the Environment Assembly will recognize that the adoption of the Night Sky Principles (or principles akin thereto) will redound across all levels of government, policy, and law to protect our night sky.

Outer Space Treaty

The United Nations Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies ("Outer Space Treaty")⁴ arguably provides a foundation for governments to protect the night sky.

³ That being said, I would be pleased to elaborate on the issues on a local or national level. For example, I recently wrote on these issues in the context of the United States' Council on Environmental Quality and its implementing regulations under the National Environment Policy Act.

⁴ The Rescue Agreement and Registration Convention do not provide any relevant provisions. The Liability Convention applies to "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations" that occurs on the "surface of the earth or to aircraft flight," "to a space object[,] . . . or to persons or property on board such a space object."

However, this foundation depends on a critical interpretation that the environment *includes* the night sky.

In 1967, the Outer Space Treaty entered into force.⁵ As of January 1, 2020, one-hundred ten countries accepted, approved, or ratified⁶ the Outer Space Treaty.⁷ Among these, the United States, the Russian Federation, and most of the European Union⁸ countries ratified the treaty. An additional twenty-three countries signed it.

Article IX of the Outer Space Treaty states:

In the exploration and use of outer space⁹, . . . States Parties to the Treaty . . . shall *conduct all their activities in outer space, . . . with due regard to the corresponding interests of all other States Parties to the Treaty.* States Parties to the Treaty shall pursue studies of outer space, . . . and conduct exploration of them so as to avoid their harmful contamination *and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter* and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space

Art. I(a), Art. II-III. Although the type of “damage” under the Liability Convention does not apply to environmental harm of a “night sky” nature in a country, see id., some suggest that “property” could include encompass damage to the professional astronomy enterprise and other endeavors that commercially rely upon the “night sky.”

⁵ Space Law Treaties and Principles, United Nations Office for Outer Space Affairs (“UNOOSA”), <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html> (last visited April 26, 2020).

⁶ For purposes of this letter, these statuses will collectively be referred to as ratified.

⁷ Status of International Agreements Relating to Activities in Outer Space as at 1 January 2020, UNOOSA, <https://www.unoosa.org/documents/pdf/spacelaw/treatystatus/TreatiesStatus-2020E.pdf> (last visited April 26, 2020).

⁸ The only two who have not ratified or signed the treaty are Croatia and Latvia.

⁹ Throughout the Outer Space Treaty, the term “outer space” includes “the moon and other celestial bodies.” For purposes of brevity, the term phrase has been omitted.

. . . , it shall undertake appropriate international consultations before proceeding with any such activity or experiment¹⁰

Preliminarily, State Parties¹¹ to the Outer Space Treaty must “conduct *all* of their activities [whether by government agencies or non-governmental entities] in outer space with due regard to the corresponding interests of all other States Parties to the Treaty.”¹² In this respect, any State Party to the treaty must implement measures to supervise such activities to ensure that interests of other State Parties will not be adversely affected. For the reasons articulated below, the unhindered use of the night sky must necessarily be considered an interest of all other State Parties to the treaty. Consequently, governments must at the minimum consider the interference outer space activities will have on the night sky.

Additionally, and more specifically to the purpose of this letter, the Outer Space Treaty requires its signatory governments to conduct outer space activities in a manner that does not adversely affect the environment through space related activities. Thus, an argument exists that the environmental clause of the treaty enjoins any activities that adversely affect the unhindered night sky. The remainder of this letter will focus on the operative clause: “*adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter.*” For Article IX to apply, the concerns over mega constellations must arise from extraterrestrial matter. Additionally, the effects of mega constellations must affect Earth’s environment. Finally, the effects must be adverse. Each of these elements can be met.¹³

¹⁰ Outer Space Treaty, UNOOSA, <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html> (last visited April 26, 2020) (emphasis added).

¹¹ Article VI of the Outer Space Treaty expressly states that each State shall be responsible for its national activities whether “carried on by governmental agencies or by non-governmental entities.”

¹² Id.

¹³ Article III of the Outer Space Treaty provides that, “States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.”

Extraterrestrial Matter

If we consider anything arriving to Earth from space to constitute “extraterrestrial matter,”¹⁴ the scope of the term within the Outer Space Treaty encompasses the light from satellites and satellite constellations observed on Earth. Even if the Outer Space Treaty intended to use “matter” in the strict scientific sense, there still exists enough of a debate on whether light or photons constitute matter¹⁵ to arguably include it within the intended use under the Outer Space Treaty. Thus, for purposes of this letter, light artificially reflecting from satellites constitutes a form of extraterrestrial matter under the treaty.

Environment Includes Night Sky

Next, the night sky must constitute a part of Earth’s environment. It does on several levels. The naked accessibility to the stars represents a critical component of our human nature. Throughout human history, the objects visible to us within the night sky worked their way into our religions, navigation, story-telling, history, and essence. Additionally, we developed astronomy and astrophysics to learn more about these phenomena. Clearly, the visible night sky should be admitted as part of our environment.

But, we can examine the question from another perspective. What threatens the dark sky? In the instant context, light. Of course, not all light is bad. The stars themselves send light. Rather, we define unwanted light – in this case artificial light or the artificial reflection of naturally occurring light - as “light pollution.” Thus, our query can be also be framed as inquiring whether light pollution constitutes an environmental problem on Earth. It does.

In a recent story, the United Nations Environment Programme stated:

For hundreds of millions of years, the web of life on land has been dependent on, and determined by, day and night, light and dark. Photosynthesis, the process by

¹⁴ There exists some debate on whether United Nations treaties should be interpreted as static documents or living documents that can be adapted and applied to developments falling within the conceptual scope of the treaty but nonetheless never anticipated by the authors or member states on adoption. Compare Sienho Yee, *The Interpretation of “Treaties in Force”* in Article 35(2) of the Statute of the ICJ, *INTERNATIONAL AND COMPARATIVE LAW QUARTERLY* 47, pp 884-904 (1998) and Alex Glashausser, *What We Must Never Forget When It is A treaty We Are Expounding*, 73 *U. CIN. L. REV.* 1243, pp. 1306-1307 (2005). For purposes here, I lean toward the latter.

¹⁵ https://www.desy.de/user/projects/Physics/Relativity/SR/light_mass.html (last visited April 26, 2020); and, for a Star-Wars-ian development, *Bonded Photons Represent a New Form of Matter*, *Cosmos: The Science of Everything*, February 19, 2018, <https://cosmosmagazine.com/physics/bonded-photons-represent-a-new-form-of-matter>.

which plants grow, depends on light and dark. And all animals depend on plants for their survival.

One of the less frequently reported impacts of human activity on the environment is the presence of artificial light. Lighting disrupts photosynthesis and the activities of insects, birds and other animals.

A recent study, Light pollution is a driver of insect declines, says habitat loss, pesticide use, invasive species and climate change have all played a role in insect declines globally, but that artificial light at night is another important—but often overlooked—cause.

* * * * *

With artificial light increasing by around 2 per cent per year globally, light pollution has become a pertinent issue.

At the Convention on Migratory Species of Wild Animals thirteenth meeting of the Conference of Parties (CMS COP13) which took place in Gandhinagar, India from 17 to 22 February 2020, delegates considered the topic for the first time following draft resolutions submitted independently by the European Union and Australia.

Artificial light not only impacts insects. Turtles, seabirds and shorebirds, and ecosystems at large, are being affected.¹⁶

Clearly, light pollution constitutes an environmental concern on a terrestrial level.¹⁷ The question arises whether the same can be said for light pollution emanating from the artificial reflection of light off of satellites. It can.

As stated above, humans have long used the stars for navigation. However, we are not alone in doing so. In an article from 2018, authors explained how a number of animal species “use the stars as a source of directional information.”¹⁸ On this, we likely have but discovered the

¹⁶ “Global light pollution is affecting ecosystems – what can we do?”, United Nations, March 13, 2020 <https://www.unenvironment.org/news-and-stories/story/global-light-pollution-affecting-ecosystems-what-can-we-do> (last visited April 27, 2020).

¹⁷ Id.

¹⁸ “How Animals Follow the Stars,” James J. Foster, Jochen Smolka, Dan-Eric Nilsson, and Marie Dacke, Proc. Biol. Sci., 2018 Jan 31, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5805938/> (last visited April 27, 2020).

tip of the iceberg in terms of the species that use the night sky.¹⁹ So, clearly, the night sky and celestial visibility also constitutes a critical component of our environment on Earth.²⁰

Should we permit pollution of the night sky to increase without limit,²¹ the adverse effects on other animals within our ecosystems will likely precipitate a cascading effect. These adverse effects could cause a decline in certain species populations which could, in turn, adversely affect other diverse organisms. These cascading effects will likely challenge our ecosystem and jeopardize a sustainable biodiversity. For fear of stepping outside my comfort zone, I will defer to others to further elaborate on the biological and environmental interrelationship between humans and other species that rely upon the night sky.

In an era of COVID-19 and so much uncertainty, it behooves us to protect our environment from all angles and approaches. This includes the recognition sought here that our environment *does* include the night sky.

UNEA-5, Impact, and Beyond

To be sure, I appreciate all efforts by the United Nations Environment Programme to address light pollution thus far. As an example, its recent reporting on these issues quoted above contributes to the broader international dialogue.

That being said, a formal recognition of the Night Sky Principles by the Environment Assembly at UNEA-5 would significantly further international efforts to mitigate light pollution terrestrially and celestially on all government levels. For, surprisingly, there exists scant formal recognition of the night sky as part of the Earth's environment. For this reason, I propose that the UNEA-5 ministers adopt in their declaration principles recognizing that:

¹⁹ National Geographic, "Dung Beetles Navigate via the Milky Way, First Known in Animal Kingdom," January 24, 2013, <https://blog.nationalgeographic.org/2013/01/24/dung-beetles-navigate-via-the-milky-way-first-known-in-animal-kingdom/> (last visited April 29, 2020). Consider also migratory birds sensing the polarization of night sky light, which skyglow can confuse (<https://jeb.biologists.org/content/141/1/241> and <https://www.sciencedaily.com/releases/2006/08/060810213154.htm>), and sea turtle hatchlings find the ocean because of its darkness against the comparative bright (natural) night sky (<https://www.nasa.gov/content/kennedy-space-center-keeps-dark-skies-for-sea-turtle-nesting>).

²⁰ Id.

²¹ Starlink has authorization for 12,000 satellites from the United States Federal Communications Commission. It seeks authorization from the ITU for an additional 30,000 more. It represents one company from one country. For comparison, there currently exist around 6,000 total satellites of which less than 3,000 operate.

Earth's natural environment includes the unblemished night sky and its visible elements;

Conduct negatively affecting the unblemished night sky and its visible elements necessarily imposes an adverse environmental impact; and,

Efforts should be implemented to minimize (if not prohibit) and mitigate adverse environmental impacts on the night sky;

At the very minimum, their inclusion in the first outline will foster comment and deliberation. They can then be refined for purposes of the advanced draft to be circulated.

Should they be adopted formally, the impact would be immediate. Indeed, the recognition that Earth's unblemished night sky constitutes a part of the environment would arguably require member countries to consider the environmental impact of its space activities – just as the Outer Space Treaty conceptually intended. It seems somehow incongruous with the Outer Space Treaty to maintain a position that light pollution from tens of thousands of satellites disrupting celestial navigation should not be an environmental impact giving rise to consideration. For, the Outer Space Treaty obligates signatory State Parties to conduct exploration²² so as to avoid “*adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter.*”

Additionally, the impact would be far-reaching. The adoption by UNEA-5 of these principles will support the interpretation of existing laws at all government levels. It also will support the promulgation of new efforts to protect Earth's night sky. Indeed, it will provide that critical but scarce formal recognition that Earth's environment includes the night sky and that artificial light or artificially reflected light that adversely effects the night sky constitutes light pollution that should be regulated.

Of course, I hope more emanates from UNEA-5 than merely the Night Sky Principles. I foresee the development of supporting content and material for each of the principles. I foresee the potential development of model policies to mitigate light pollution. Alternatively, it might lead to the recognition of existing model policies. I foresee the potential for collaboration among interested parties at UNEA-5 in committee or broader discussion. I foresee invitations and participation by diverse actors.

Beyond UNEA-5, I foresee the interaction between segments within the United Nations. For example, I could see collaboration between the Environment Programme, on the one hand, and UNOOSA or COPUOS, on the other hand. Should UNOOSA continue its conferences

²² Although the “use” is not specifically included in this clause, the Treaty clearly must intend that “exploration” necessarily includes “use.” For, it would be illogical to constrain exploration of space and not its use.

and/or workshops on Space Law and Policy, there could be a collaborative effort to discuss and debate the future of the environment as it relates to space.

Further in the future, such dialogue might lead to the development of a treaty or principles affecting the colonization of celestial bodies and principles for protecting new terrestrial environments.

In all of these environmental deliberations, UNEA-5 can lead the way.

Conclusion

By this letter, I contribute my input and ideas for UNEA-5 in particular relation to the night sky as an integral component of our natural environment. I articulated three Night Sky Principles that can contribute significantly to the interpretation of existing law and fuel advocacy for increased environmental protection for the night sky. Indeed, the adoption of these principles by the Environment Assembly will facilitate broader interpretation of the United Nations Outer Space Treaty (as articulated above), provide support for the adoption and interpretation of laws within member states, and encourage citizens and more localized governments to recognize the night sky as part of our environment.

I appreciate the Environment Assembly's consideration of my contribution. I would very much welcome any opportunity to continue my involvement in this regard.

Sincerely,

A handwritten signature in black ink, appearing to read 'CLM', with a horizontal line extending to the right.

Charles Lee Mudd Jr.

CLM/mms