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Cosmic Harmony: Revitalising International Space Law for Ethical Space Colonisation through an Ecocentric Lens

Author: Agapi Antonaki
Supervisor: Elina Pirjatanniemi

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ABSTRACT

In the age of the Anthropocene, plans for human settlements in outer space pose one of the biggest threats to the enjoyment of human rights and the protection of the environment per se. This thesis explores how an ecocentric perspective, combining cosmocentrism and environmental principles, can enhance international space law to govern space colonisation as an environmental issue. Emphasising the intrinsic value of celestial bodies and recognising the interdependence between humans and the cosmic ecosystem, a cosmocentric ethic offers a promising pathway for ethical space colonisation. Through a multidisciplinary methodology involving international space law, environmental law, human rights and ethics, this research highlights the relevance of an ecocentric approach in addressing the ethical challenges introduced by space activities and advocates for responsible stewardship of the environment in space colonisation endeavours. By applying environmental principles such as precaution, common but differentiated responsibilities (CBDR) and sustainability, this study strengthens the international space law regime to address potential ecological impacts. The research demonstrates the significance of a cosmocentric perspective in establishing an inclusive and equitable framework that protects the rights of nature and future generations, promoting harmonious relationships with the celestial environment on Earth and beyond.

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TABLE OF ABBREVIATIONS

ATS	Antarctic Treaty System
CBDR	Common but Differentiated Responsibility
CHAPEA	Crew Health and Performance Exploration Analog
CNSA	China National Space Administration
COSPAR	Committee on Space Research
CRC	Convention on the Rights of the Child
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ESA	European Space Agency
FAA	Federal Aviation Administration
IAA	International Academy of Astronautics
IACtHR	Inter-American Court of Human Rights
IADC	Inter-Agency Space Debris Coordination Committee
ICJ	International Court of Justice
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ISRO	Indian Space Research Organization
ITLOS	International Tribunal for the Law of the Sea
JAXA	Japan Aerospace Exploration Agency
LEA	Lower Earth Orbit
MA	Moon Agreement
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NPS	Nuclear Power Sources

OAS	Organization of American States
OAU	Organization of African Unity
OST	Outer Space Treaty
OHCHR	Office of the High Commissioner for Human Rights
RFSA	Russian Federal Space Agency
SDGs	Sustainable Development Goals
SIA	Sustainability Impact Assessment
UAE	United Arab Emirates
UN	United Nations
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNSG	United Nations Secretary-General
USA	United States of America
US DDC	United States District Court for the District of Columbia
VCLT	Vienna Convention on the Law of Treaties
WCED	World Commission on Environment and Development

1. Introduction

Space exploration and colonisation have become crucial components of human advancement, expanding our knowledge and capabilities beyond the confines of our home planet. However, as we venture deeper into the cosmos, we must acknowledge that our operations in space hold profound environmental implications. Humans have already caused irreparable environmental damage on Earth — evident primarily from climate change — which will be extended into outer space if we continue business as usual.

In the New Space era, human activity in outer space has increased, while numerous enterprises are making plans towards this direction. Most notably, billionaire Elon Musk founded SpaceX back in 2002 with the goal of establishing a permanent human colony on Mars. On April 20, 2023, the debut launch of Starship – SpaceX's fully reusable spacecraft and the largest and most powerful rocket humanity has ever assembled – took place, however unsuccessfully. Starship's mid-flight failure and subsequent explosion led to environmental consequences. A group of environmental organisations sued the United States (US) Federal Aviation Administration (FAA),[1] which approved Starship's launch without requesting a more comprehensive evaluation of the ecological ramifications. The coalition claimed that the agency did not properly assess the potential damage to the ecosystem of a national wildlife rescue near Boca Chica State Park, as well as the harm to endangered species, migratory birds, and human communities around Starbase, SpaceX's launch site. They requested that the court invalidates the launch authorisations until the FAA undertakes a complete environmental impact study. Musk has distinctly proclaimed in 2020 that, with respect to the proposed Mars settlement, Martian endeavours should not be subject to governance or jurisdiction by any terrestrial governmental entity, declaring the freedom of Mars.[2] SpaceX has vehemently resisted the inclusion of its

[1] *Center for Biological Diversity et al. v Federal Aviation Administration et al.* (2023) 1:23-cv-01204 (DCD); Steve Gorman, 'Environmental Groups Sue US over SpaceX Launch License for Texas' (2023) <www.reuters.com/technology/space/environmentalists-sue-faa-over-spacex-launch-license-texas-2023-05-01/> All links accessed 14 July 2023.

[2] Stacy Liberatore, 'Elon Musk's SpaceX Will Not Recognize Earth Laws in Mars Colony' (2020) <www.dailymail.co.uk/sciencetech/article-8897601/Elon-Musks-SpaceX-says-not-recognize-Earth-laws-planned-Mars-colony.html>.

Starbase within the scope of an environmental impact statement (EIS) evaluation, which would entail comprehensive examination of the project in question, offering alternative options, including inaction, as well as the formulation of measures to minimise adverse effects.[3] Furthermore, the National Aeronautics and Space Administration's (NASA) project 'Mars Dune

[3] Gorman (n 1).

Alpha', the first of the three Crew Health and Performance Exploration Analog (CHAPEA) missions, which is a simulation of realistic living conditions on Mars at Houston's Johnson Space Center, commenced on June 25, 2023. During the project, four astronauts will remain in a 3D-printed habitat for over a year, so NASA can research the optimal design and plan for future missions to Mars. In addition, Jeff Bezos' Blue Origin signed a contract with NASA in May 2023 to develop a human lander on the lunar surface for Artemis V programme,[4] to send crew to the Moon during the next decade, for week-long stays, while Artemis VII, VIII and/or IX will aim at the establishment of permanent habitation.[5] Meanwhile, the China National Space Administration (CNSA) plans to start putting up permanent lunar settlements by 2028 and land astronauts on the Moon by 2030.[6] A significant step to the direction of space settlements was made in March 2023, when they declared that they managed to harvest rice seeds on the Chinese Tiangong space station.[7]

The need for a paradigm shift and regulation is urgent, as the unregulated exploitation and colonisation of celestial bodies could have far-reaching consequences for both Earth and the extraterrestrial environments we encounter. Keeping in mind the grave errors humans have made in the exploration and utilisation of terrestrial ecosystems, scholars speculate on the potential consequences that would arise from exploiting an extraterrestrial environment[8]. To address these challenges, it is essential to examine the existing international space legislation and the ethics underlying it, and explore avenues for informing and shaping space law to address the potential ecological impacts of space colonisation, ensuring ethical practices in space.

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[4] Claire O'Shea, 'NASA Selects Blue Origin as Second Artemis Lunar Lander Provider' (2023) <http://www.nasa.gov/press-release/nasa-selects-blue-origin-as-second-artemis-lunar-lander-provider>.

[5] Tariq Malik, 'NASA May Build More than One Moon Base for Artemis Lunar Missions' (2023) <www.space.com/nasa-artemis-base-camp-more-moon-bases>.

[6] Vivian Wang, 'China Announces Plan to Land Astronauts on Moon by 2030' (2023) <www.nytimes.com/2023/05/29/world/asia/china-space-moon-2030.html>.

[7] Peter Singer and Thomas Corbett, 'China 'Colonizes' Space with Its First Rice Harvest' (2023) <www.defenseone.com/ideas/2023/03/china-colonizes-space-its-first-rice-harvest/384285/>.

[8] Aldo Cocca and others, 'Autonomous Settlements and Environmental Protection in the Law of Outer Space' (2001) 44 Proceedings on the Law of Outer Space 337, 339.

The central research question of this thesis is: How can an ecocentric approach, combining cosmocentrism and environmental principles, enhance the existing international space law framework to facilitate the effective governance of space colonisation as an environmental issue? This research seeks to investigate the potential of an ecocentric, specifically cosmocentric, perspective, which prioritises the intrinsic value of all components of the cosmic ecosystem and recognises the interdependence between humans and the environment. Intrinsic value is 'a meta-ethical concept that is defined as that value of an object that is independent of a valuer'.[9] As opposed to anthropocentrism[10] — which places intrinsic value solely to humans and views the environment and all other beings as having only instrumental value —, ecocentrism considers nature as having intrinsic value[11] and humans are perceived as part of a broader ecosystem.[12] Drawing upon the principles of cosmocentrism, this thesis will explore the philosophical underpinnings that view the universe as a holistic entity deserving of moral consideration. By integrating these principles with environmental ethics, which emphasise the responsible stewardship of the natural world, a comprehensive framework can be constructed to guide the ethical conduct of space activities. The thesis will examine the current international space legal framework's strengths and weaknesses in addressing environmental issues and will identify gaps in the main space treaties. Using a cosmocentric approach, this research seeks to provide suggestions and propose a different interpretation of the international space legislation to ensure the conservation of celestial bodies, while focusing on the importance of the ethics that underline law.

Nonetheless, this research is subject to several limitations. The first one concerns the number of principles that will be examined. Given the scope of the thesis, focus will be placed

[9] Martyn Fogg, 'The Ethical Dimensions of Space Settlement' (2000) 16 Space Policy 205, 207 <http://dx.doi.org/10.1016/s0265-9646(00)00024-2>.

[10] For traditional anthropocentric views, see eg Vernon Bourke, *History of ethics* (Doubleday 1968).

[11] Vito De Lucia, 'Beyond Anthropocentrism and Ecocentrism: A Biopolitical Reading of Environmental Law' (2017) 8 Journal of Human Rights and the Environment 181, 183 <http://dx.doi.org/10.4337/jhre.2017.02.01>.

[12] Hugh McDonald, *Environmental Philosophy A Revaluation of Cosmopolitan Ethics from an Ecocentric Standpoint* 3 (Value Inquiry Book Series 273, 2014).

only on the principles of precaution, common but differentiated responsibility (CBDR) and sustainability, as the most relevant ones regarding space colonisation and the closest ones to ecocentrism. The second limitation is the limited data and research available on the environmental consequences of space colonisation. As the latter is still in its infancy, there is little empirical data, and extensive scientific study is needed to understand the full extent of these ecological impacts, which might be scarce at this stage. This lack of research may pose challenges in developing clear criteria for regulating space colonisation. The third limitation is the lack of enforcement mechanisms in international space law. While the latter offers a framework with fundamental principles on how space activities should be carried out, enforcing environmental ideals and ethical standards can be challenging. Without adequate enforcement measures, adherence to ecocentric concepts in light of space settlements may remain voluntary and at the discretion of States and private space-faring enterprises. The last limitation of this study is the evolving nature of space activities. New technologies and projects relating to space exploration are constantly developing. The challenges regarding the protection of the outer space environment and the needs for regulation may alter as space activities evolve. Thus, to remain relevant and address emerging difficulties in space colonisation, the research question may need to be revisited throughout time.

To conduct this research, primary sources will be studied, such as international treaties, legal documents and relevant cases, as well as secondary sources, such as academic papers, law journals, books and websites. Specifically, secondary sources will be used to explain the main principles of ecocentrism and investigate the feasibility of its application to the outer space environment. Moreover, secondary sources on ecocentrism will be utilised to analyse international space law critically, pointing out their legal gaps regarding the protection of the environment. Afterwards, primary sources, namely the Stockholm Declaration[13] and the Rio Declaration,[14] will be used as a tool to interpret the existing environmental provisions of space

[13] United Nations Environment Programme (UNEP), Stockholm Declaration: Declaration on the Human Environment, UNEP 16/0 <https://wedocs.unep.org/20.500.11822/29567> [hereinafter Stockholm Declaration].

[14] Rio Declaration on Environment and Development, UN Doc. A/CONF.151/26 (vol. I), 31 ILM 874 (1992) [hereinafter Rio Declaration].

law and fill in the legal gaps. Lastly, secondary sources on ecocentrism will be utilised to critique the current status of the environmental principles and propose a lex ferenda.

A multidisciplinary method will be used, including elements of space law, environmental law, human rights and ethics. The research methodology used in this thesis is a combination of doctrinal and critical methods. A doctrinal method will partly be used, as existing legal instruments will be analysed and applied in order to interpret international space law treaties. On the other hand, legal texts will be examined from a critical perspective, using cosmocentrism as a lens. An ecocentric theoretical framework will also be adopted, on which I will base my analysis and proceed with the application of environmental principles to outer space.

Primarily, Chapter 2 will briefly provide context discussing the ecological impact humans have caused in the age of the Anthropocene, demonstrating how the environment and human rights are interdependent and highlighting the need for an ecocentric model of climate justice in the governance of space activities, following the example of the rights of nature movement. Secondly, Chapter 3 will discuss the current plans of establishing permanent human settlements in outer space, examining the arguments for such plans and, on the other hand, envisaging the ethical dilemmas, the human rights violations and the environmental implications they might lead to. Thirdly, Chapter 4 will investigate the principles of astroenvironmentalism, arguing for a cosmocentric approach as a way of analysing and addressing the issue of space colonisation, based on intra- and intergenerational ethics, and indigenous peoples' views. Afterwards, Chapter 5 will explore the current international space law regime, focusing on the legality of space colonisation and the concept of 'common heritage of mankind', and examining the environmental provisions found in the main treaties, identifying the legal gaps and stressing the need for alternatives. Additionally, Chapter 6 will analyse the possibility of filling the legal gaps of the current international space law framework with the environmental principles of precaution, CBDR and sustainability, all three derived from soft law. I will argue for the feasibility of such application de lege lata, while at the same time providing a critique through a cosmocentric lens and arguing for the protection of the environment per se, de lege ferenda.

Lastly, Chapter 7 will provide a concise overview and interpretation of the main findings, outlining potential avenues for future research.

2. Background and context

2.1. Climate change in the age of the Anthropocene

Climate change is an intricate and multidimensional phenomenon, exerting an impact on the Earth's climate system and the livelihoods of the global population. The term is defined in Article 1.2. of the United Nations Framework Convention on Climate Change (UNFCCC) as ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’.[15] Climate change has predominantly been attributed to human activities, particularly the combustion of fossil fuels, dating back to the 19th century.[16] This phenomenon provides irrefutable proof that human civilization has violated the basic rules of the earth community.[17] The implications of this warming are significant and far-reaching on both the environment and human health.

Scientists have indicated climate change as beyond reasonable doubt[18], and scholars have characterised it as a ‘wicked problem’[19], and the ultimate tragedy of the commons.[20] Global warming poses a critical human rights challenge, since it endangers fundamental human rights

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[15] UN General Assembly, United Nations Framework Convention on Climate Change (1994) A/RES/48/189 <www.refworld.org/docid/3b00f2770.html>.

[16] Especially since 1970, humans have been to blame for all the greenhouse gases released, contributing to climate change. See Joseph Romm, *Climate Change: What Everyone Needs to Know*® 7 (Oxford University Press 2018); See also UN, ‘What Is Climate Change?‘ (2021) <www.un.org/en/climatechange/what-is-climate-change>

[17] Cormac Cullinan, ’Wild Law and the Challenge of Climate Change‘ (2007) 37 Soundings 116, 125 <http://dx.doi.org/10.3898/136266207820465525>.

[18] Valerie Masson-Delmotte and others (eds), ’Intergovernmental Panel on Climate Change (IPCC) 2021: Summary for Policymakers in Climate Change 2021: The Physical Science Basis‘, WG 1 AR6, 276 (2021).

[19] Mike Hulme, *Climate Change* 17 (Routledge 2022).

[20] Elizabeth Fisher, *Environmental Law: A Very Short Introduction* 88 (Oxford University Press 2017).

such as the right to life, health, access to food, water and housing, as well as self-determination and cultural identity. More importantly, it abuses the human rights of already vulnerable individuals.[21] The impact on their rights can be more severe due to their heightened exposure, and may lead to forced migration, water or food insecurity, loss of livelihood and occurrence of various illnesses.[22] Climate change could affect the whole spectrum of human rights, but primarily the right to life, health, food, water, housing, and the right to self-determination.[23]

Climate change indicates that we have reached the age of the Anthropocene.[24] The latter was introduced by scientists Crutzen and Stoermer,[25] and is a proposed geological epoch. It is defined by the significant impact humankind, as the major ecological force, has on the environment because of the increased energy usage and the population expansion. Its distinctive characteristics include the human dominance over the Earth's ecosystems and the anthropogenic mass extinction of flora and fauna caused by overconsumption and the exploitation of resources, reinforced by the industrial and technological evolution,[26] which is feeding our growth mania, inherent to our capitalist structures. The endless desire to alter the environment lingers because 'this active attack on the environment is the most prominent fact in his [the human's] existence'.[27] The Anthropocene is not currently formally recognised, so we are still within the

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[21] Martin Parry and others (eds), 'IPCC 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability', WG II AR4, 374 (2007).

[22] Office of the High Commissioner on Human Rights (OHCHR), 'The Impacts of Climate Change on the Human Rights of People in Vulnerable Situations', UN Doc A/HRC/50/57 (2022) <www.ohchr.org/en/documents/thematic-reports/ahrc5057-impacts-climate-change-human-rights-people-vulnerable>.

[23] OHCHR, 'The Relationship Between Climate Change and Human Rights', UN Doc A/HRC/10/61 (2009), 8ff.

[24] Fisher (no 7) 67.

[25] Paul Crutzen and Eugene Stoermer, 'The "Anthropocene" ' (2000) 41 IGBP Global Change Newsletter 17.

[26] Joseph Stromberg, 'What Is the Anthropocene and Are We in It?' (2013) <https://www.smithsonianmag.com/science-nature/what-is-the-anthropocene-and-are-we-in-it-164801414/>; See also Will Steffen and others, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?' (2007) 36 AMBIO: A Journal of the Human Environment 614, 614-621 <http://dx.doi.org/10.1579/0044-7447(2007)36[614:taahno]2.0.co;2>.

[27] Bernard Stiegler, *Dans la disruption. Comment ne pas devenir fou?* 93 (Les Liens qui Libèrent 2016).

Holocene epoch[28], but efforts are made towards this direction. Various scholars, following the views of postcolonial and posthuman literature, argue that the Anthropocene is entrenched on colonialism and slavery,[29] practices that scarred the history of humankind. However, Mitchell warns that if we link colonialism and the Anthropocene, this might result in a naturalisation of such practices.[30] Building on from this idea, one can only imagine what risks this entails considering the progress in the space sector; humans are already pushing the limits or even going beyond the Anthropocene considering the likelihood of expanding off-Earth.[31]

In conclusion, the Anthropocene bears within it an unprecedented environmental crisis, as a result of anthropogenic modifications to Earth's climate and ecosystems. The daunting future calls for socially 'reconceptualizing the Anthropos',[32] the human, and challenging the dominant position the latter holds in the current era.[33]

2.2. The interrelation between the environment and human rights

Human rights and the environment have typically been researched and managed independently but, in recent decades, their interconnectedness and interdependence have grown more apparent.

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[28] Dipesh Chakrabarty, 'Postcolonial Studies and the Challenge of Climate Change' (2012) 43 New Literary History 1, 11 <http://dx.doi.org/10.1353/nlh.2012.0007>; Working Group on the 'Anthropocene', Subcommission on Quaternary Stratigraphy <http://quaternary.stratigraphy.org/working-groups/anthropocene/>.

[29] Kyle Whyte, *Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing the Anthropocene* 159 (Duke University Press 2017); Matthew Kearnes and Thom van Dooren, 'Rethinking the Final Frontier: Cosmo-Logics and an Ethic of Interstellar Flourishing' (2017) 3 GeoHumanities 178, 182 <http://dx.doi.org/10.1080/2373566x.2017.1300448>; See also Alessandra Marino, 'Astroenvironmentalism as SF' (2023) 15 Environmental Humanities 25, 37 <http://dx.doi.org/10.1215/22011919-10216140>.

[30] Audra Mitchell, 'Decolonising the Anthropocene' (2015) <https://worldlyir.wordpress.com/2015/03/17/decolonising-the-anthropocene/> (last modified 17 March 2015).

[31] Clive Hamilton and others, 'Thinking the Anthropocene' in Clive Hamilton and others (eds) *The Anthropocene and the Global Environmental Crisis: Rethinking Modernity in a New Epoch* (Routledge 2015).

[32] Gisli Palsson and others, 'Reconceptualizing the 'Anthropos' in the Anthropocene: Integrating the Social Sciences and Humanities in Global Environmental Change Research (2013) 28 Environmental Science & Policy 3, 4 <http://dx.doi.org/10.1016/j.envsci.2012.11.004>.

[33] Marina de Figueiredo and Fábio Marquesan, 'Back to the Future: Ecocentrism, Organization Studies, and the Anthropocene' (2022) 38 Scandinavian Journal of Management 2, 7 <http://dx.doi.org/10.1016/j.scaman.2022.101197>.

Traditionally, Western legal systems have prioritised individual rights over environmental conservation.[34] For a long time, humankind has been considering the environment solely as property to be exploited.

Humans have embraced this self-proclaimed supremacy long enough to cause a massive deterioration of the environment and extinction of wildlife. Humans have managed to persuade themselves that they can flourish through this hegemonic myth they have built and sustained.[35] In reality, the environment is not only a sine qua non for the enjoyment of human rights, such as the right to life, health water and food; it also belongs in the realm of the protection of human rights itself, as highlighted by the growing recognition of the right to a healthy and clean environment.[36] In the name of economic development, we have sacrificed nature and depleted its resources. However, we are dependent on our natural habitat, and without an acceptable environment even our profit-driven interests are unattainable.[37] Humans can be well-rounded and protected only when in harmony with their natural environment, which provides them with food, water, air and other resources essential for their survival and well-being. It also protects them from extreme weather events or virulent diseases' outbreaks and supports their physical and mental health. The latter is often ignored, but our overall well-being is indissolubly connected to our natural surroundings, since it inevitably coexists with nature's inherent goodness.[38] Lastly, a genetic influence on humans and societies globally can be observed, in cases where their environment has changed.[39]

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[34] Fisher (n 7) 43.

[35] Cullinan (n 3) 58.

[36] See UNGA, 'The Human Right to a Clean, Healthy and Sustainable Environment Resolution', UN Doc A/76/L.75 (2022) <https://digitallibrary.un.org/record/3982508?ln=en>; Case concerning the Gabčikovo-Nagymaros Project, Judgement, ICJ REPORTS 1997, 91; Steven Freeland and Danielle Ireland-Piper Space Law, Human Rights and Corporate Accountability (2022) 26(1) UCLA Journal of International Law and Foreign Affairs 1, 17 < https://escholarship.org/uc/item/3636p0sp>.

[37] McDonald (no 12), 1.

[38] Grzegorz Francuz, 'Nature and Intrinsic Value' (2020) LXVII Principia 49, 49 <http://dx.doi.org/10.4467/20843887pi.20.003.13833>; See also Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future* 29-30 (Studies in Space Law 3, Brill | Nijhoff 2008), on how environmental degradation has created health issues.

[39] René Dubos, *Man and His Environment* 300 Britannica Perspectives 1, Encyclopaedia Britannica1968). Also see CD Darlington, *The Evolution of Man and Society* 705 (1st eds, Simon & Schuster 1970).

The interdependence between human rights and the environment is highlighted in the Report of the OHCHR on the relationship between human rights and the environment.[40] The report mentions, inter alia, three – potentially interrelated – arguments on the nature of this relationship.[41] First, the enjoyment of human rights depends on the environment. This approach emphasises that the rights to life and human dignity can only be safeguarded if humans live in a healthy environment. The second approach uses human rights to address environmental challenges procedurally and substantively. The third strategy combines human rights and sustainable development. Furthermore, several treaties and legal instruments highlight the importance of environmental protection and the right to a healthy and safe environment, such as the Convention on the Rights of the Child (CRC)[42], the African Charter on Human and People's Rights[43] and the Additional Protocol to the American Convention on Human Rights.[44]

In conclusion, humans are interrelated to their environment, despite their ongoing efforts to prove otherwise. Current legal systems, especially in the West, are still anthropocentric for the most part; however, the link between human rights and the environment is progressively coming to the surface and is already of concern to the international community.

2.3. The emergence of the rights of nature and the shift towards ecocentrism

Environmental problems combine multiple and interrelated dimensions, such as legal, social, ethical, scientific, economic and political ones. They are extremely complex and involve

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[40] OHCHR, 'Analytical Study on the Relationship Between Human Rights and the Environment' UN Doc A/HRC/19/34 (2011) 5-6 < https://digitallibrary.un.org/record/718748?ln=en>.

[41] ibid 4.

[42] UNGA, *Convention on the Rights of the Child*, 1577 UN Treaty Series 3 (1989) art 24 para 2(c) <https://www.refworld.org/docid/3ae6b38f0.html>.

[43] Organization of African Unity (OAU), *African Charter on Human and Peoples' Rights ('Banjul Charter')*, CAB/LEG/67/3 rev. 5, 21 I.L.M. 58 (1982), <www.refworld.org/docid/3ae6b3630.html>.

[44] Organization of American States (OAS), *Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights ('Protocol of San Salvador')*, A-52 (1999) <www.refworld.org/docid/3ae6b3b90.html>.

numerous actors due to their transnational[45] and complicated nature. They are hard to regulate into the existing structures which are strongly anthropocentric.

In the age of the Anthropocene, the legal protection of 'the voiceless' has been proven even more challenging. This category includes wildlife, natural resources and future generations.[46] The voiceless are defenseless and cannot protect themselves effectively in the existing legal regime. Hence, the issue of how to determine the appropriate representatives for those that lack their capacity to express their interests arises. Stone proposes a model of guardianship to resolve their legal matters,[47] while Medlock and White suggest that we pay attention to the voiceless' non-verbal signs.[48] The protection of the voiceless agrees with the ecocentric paradigm, which recognises their intrinsic value and considers the voiceless as rightsholders. Thus, by recognising the interests of other-than-human animals,[49] ecosystems and geological diversity, ecocentrism fosters a truly democratic and inclusive ethos,[50] as the voiceless exceed humans in numbers.

The view of the above-mentioned entities as rightsholders can already be observed in some parts of the world, where the rights of nature are gradually emerging in an ecocentric direction. For instance, the Ecuadorian Constitution establishes that individuals should live in harmony with nature, while States and corporations have an obligation to respect nature and recognise its rights, and it highlights that the latter are legally enforceable.[51] A decade later, the

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[45] Fisher (n 7) 46, 83.

[46] Randall Abate, *Climate Change and the Voiceless: Protecting Future Generations, Wildlife, and Natural Resources* xii (Cambridge University Press 2019).

[47] Christopher Stone, *Should Trees Have Standing?: Law, Morality, and the Environment* (Oxford University Press 2010).

[48] Frances Medlock and Rob White, 'Ecocide, Ecocentrism and Social Obligation' (2022) 15 Erasmus Law Review 142, 147 <http://dx.doi.org/10.5553/elr.000220>.

[49] I will use the term 'other-than-human' animals instead of 'non-human' animals, as the latter still entails a shred of anthropocentrism.

[50] Helen Kopnina and others, 'The "Future of Conservation" Debate: Defending Ecocentrism and the Nature Needs Half Movement' (2018) 217 Biological Conservation 140, 146 <http://dx.doi.org/10.1016/j.biocon.2017.10.016>.

[51] Preamble and arts 71,72, Constitución Política de la República del Ecuador 2008; See also Cullinan (no 3) 206-207.

Inter-American Court of Human Rights (IACtHR) published an influential Advisory Opinion[52] recognising the right to a healthy environment as a fundamental human right and defining State obligations for its protection. Moreover, the Whanganui river and Te Urewera region in New Zealand are legally protected, with the State of New Zealand and the Maori community as their guardians and spokespeople.[53] In addition, the Earth democracy movement in India and the Earth Justice movement in South Africa are growing,[54] while indigenous ideas with ecocentric roots gain prominence.[55] Lastly, international environmental law is dipping its toe in ecocentrism,[56] with no recent notable developments, though. Nevertheless, more and more voices are rising globally, highlighting the importance of a paradigm shift.

2.4. The need for an ecocentric climate justice in the New Space era

As global environmental consciousness grows, so do technological advancements and private enterprises' desire to expand their activities and conquer the 'final frontier': outer space. The New Space era, with the US at the forefront, has signified the privatisation of access to outer space[57] and the resurgence of space exploration and technological innovation in this sector since the early 21st century. Countless space activities are planned and executed daily by major

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[52] Maria Banda, 'IACtHR "Advisory Opinion on the Environment and Human Rights"' 7 (2018) <www.asil.org/insights/volume/22/issue/6/inter-american-court-human-rights-advisory-opinion-environment-and-human>.

[53] Te Awa Tupua (Whanganui River Claims Settlement) New Zealand Act 2017; Te Urewera Act 2014 New Zealand; See also Benjamin Richardson, 'Space Matters: Environmental Law's Spatial Character and Context' (2021) 34 Journal of Environmental Law 379, 385-386 <http://dx.doi.org/10.1093/jel/eqab039>.

[54] Cullinan (no 3) 172-173.

[55] Ibid, p. 202 (Cullinan)

[56] See eg Secretary of the Antarctic Treaty (ATS), *1959 Antarctic Treaty*, 402 UNTS 71, 12 UST 794, 19 ILM 860 (1980), Cmnd 1535, ATS 12 (1961); Secretary of the Convention on Biological Diversity, *1992 Convention on Biological Diversity*, 1760 UNTS 79, 31 ILM 818 (1992); Fengna Xu, 'Environmental Protection in the Exploitation and Use of Space Resources' (2020) 565 IOP Conference Series: Earth and Environmental Science 1, 3-4 < 10.1088/1755-1315/565/1/012003>.

[57] Anne Martin and Steven Freeland, 'From One to Many: "Mega" (Constellation) Challenges to the Legal Framework for Outer Space' (2021) 46 Annals Air & Space L 131, 134.

corporations, and the commercialisation of space activities poses tremendous challenges for humanity. The New Space era has also been labeled as ’Space Exploration 3.0’,[58] emphasising the compound of private enterprises with States in space exploration in the pursuit of economic development.

Capitalism, as the dominant economic system, is driven by an insatiable need for growth,[59] which has resulted in social inequity, the depletion of natural resources and environmental degradation. As humans spread in the cosmos, capitalism seeks new frontiers to conquer. As humankind embarks upon extraterrestrial undertakings, the spotlight must be on the environmental protection of outer space, to prevent patterns that have already plagued our terrestrial history. However, Hickel argues that capitalism and the protection of the environment do not go hand in hand[60]. Exploiting the extraterrestrial environment could have detrimental consequences for humanity.[61] Especially considering that private entrepreneurs tend not to be as concerned about environmental matters, there seems to be no end in the vicious circle of growth beyond the Earth’s limits. To reverse this, we should be cautious and anticipate the environmental impacts of our interaction with outer space. Moreover, scholars argue that in the New Space era the technological and economic development expresses ideas and ambitions of mostly rich white men from North-Western countries and favours developed countries and affluent individuals at the expense of developing countries, adding to the gap between them.[62] Hence, immediate multilevel action is needed to bridge this gap.

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[58] Pascale Ehrenfreund and Nicolas Peter, ’Toward a Paradigm Shift in Managing Future Global Space Exploration Endeavors‘ (2009) 25 Space Policy 244, 245 <http://dx.doi.org/10.1016/j.spacepol.2009.09.004>.

[59] Fred Magdoff and John Bellamy Foster, *What Every Environmentalist Needs to Know about Capitalism,* (Monthly Review Press 2011).

[60] Jason Hickel, ’Why Growth Can’t Be Green‘ (2018) <https://foreignpolicy.com/2018/09/12/why-growth-cant-be-green/>; Konrad Szocik and Michael Reiss, ’Why Space Exploitation May Provide Sustainable Development: Climate Ethics and the Human Future as a Multi-Planetary Species‘ (2023) 147 Futures 103, 105 <http://dx.doi.org/10.1016/j.futures.2023.103110>.

[61] Cocca (no 8) 339.

[62] Nandasiri Jasentuliyana, 'Article I of the Outer Space Treaty Revisited' (1989) 17 Journal of Space Law 129, 142; Ida Bagus Rahmadi Supancana, 'Commercial Utilization of Outer Space and its Legal Formulation Developing Countries Perspectives' (1991) 34 Proclamations on the Law of Outer Space 348, 348; Micha Rahder, ’Home and Away‘ (2019) 10 Environment and Society 158, 161 <http://dx.doi.org/10.3167/ares.2019.100110>.

To that end, Ireland-Piper and Freeland propose a human rights-based approach[63] which will effectively safeguard the human rights affected by space activities.[64] A human rights-based model encompasses one of the most effective concepts to tackle climate change, namely the concept of climate justice.[65] Climate justice, as a term, acknowledges climate crisis both as an environmental and as a sociopolitical issue. This concept arose from the belief that affluent countries, fossil fuel companies and powerful individuals bear historical responsibility for environmental destruction,[66] which jeopardises human rights. Climate justice emphasises the reality that the negative effects of climate change are not distributed evenly across people, since the harshest outcomes of climate change are felt by those who are most at risk and least to blame for this calamity.[67] Scholars confirm that climate justice, if applied to space exploration, will resolve various issues surrounding our space endeavours.[68]

Climate justice, when associated with ecocentrism, will acknowledge the interdependence of all living and non-living beings. Nevertheless, instead of adopting the ecocentric perspective, many approaches to climate justice still rely on the anthropocentric paradigm that prioritises human interests. However, the anthropocentric model fails to concede that safeguarding human rights is contingent on the preservation of the ecosystems. An anthropocentric approach can only provide a temporary remedy to human rights infringements. It is argued that this demonstrated unsuccessful model should not be followed in our encounters

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[63] Freeland, Steven, Ireland-Piper, Danielle, Space Law, Human Rights and Corporate Accountability, UCLA Journal of International Law and Foreign Affairs, Volume 26, Issue 1 (2022), 9

[64] Danielle Ireland-Piper and Steven Freeland, 'Human Rights and Space: Reflections on the Implications of Human Activity in Outer Space on Human Rights Law' (2021) 9 Groningen Journal of International Law 101 <http://dx.doi.org/10.21827/grojil.9.1.101-127>.

[65] Bridget Lewis, "Human Rights Duties towards Future Generations and the Potential for Achieving Climate Justice" (2016) 34 Netherlands Quarterly of Human Rights 206 <http://dx.doi.org/10.1177/016934411603400303>, 206; Aliozi Z. in Regina Paulose (ed), Green Crimes and International Criminal Law (Vernon Press 2021), 1; Chukwumerije Okereke, "Climate Justice and the International Regime" (2010) 1 Wiley Interdisciplinary Reviews: Climate Change 462 <http://dx.doi.org/10.1002/wcc.52>, 471.

[66] Zoi Aliozi, 'Climate Justice and Human Rights, in a World in Climate Emergency', Global Campus Europe 1, 8.

[67] Ibid 4 (Aliozi)

[68] Peter Timko and others, 'Exploring the Extraplanetary: Social Studies of Outer Space' (2022) 38 Anthropology Today 9, 11 <http://dx.doi.org/10.1111/1467-8322.12726>; Julie Klinger, 'Environmental Geopolitics and Outer Space' (2019) 26 Geopolitics 666, 666 <http://dx.doi.org/10.1080/14650045.2019.1590340>.

with extraterrestrial life;[69] Western anthropocentric notions, also embedded in the legislation, view nature as an object to exploit; they have shaped our perception of reality so profoundly that we struggle to envision alternative ways of existing in harmony with the environment. Latour criticises this relationship we have established with the environment, advocating for a more democratic model.[70] This model would be more inclusive, taking into account the interests of the voiceless, which form the majority in the existing ecosystems. An ecocentric climate justice would effectively consider the rights of future generations, safeguarding their rights through a sustainable way of living, in harmony with the environment.

Abate accentuates that an ecocentric model is the only valid solution,[71] while Leopold urges humanity not to view the environment from the prism of 'the slave and the servant', and to adopt the role of the member instead of the one of the conqueror.[72] Only then will the rights of the voiceless be respected, and celestial ecologies will be preserved. Climate justice is an essential requirement for the viability of ecocentrism in the future,[73] while climate justice cannot flourish and effectively address both social injustice and the protection of the environment if it remains attached to the anthropocentric paradigm.

3. Space colonisation

3.1. Definitions and current plans to become multiplanetary

[69] Rob Amos, International Conservation Law: The Protection of Plants in Theory and Practice (Routledge 2020), 11.

[70] Bruno Latour, *Politics of Nature: How to Bring the Sciences into Democracy* (Catherine Porter trs, Harvard University Press 2004); Bruno Latour, 'For David Bloor… and Beyond: A Reply to David Bloor's 'Anti-Latour'' (2017) 27 Philosophical Literary Journal Logos 80, 81-11 and 113-29 <http://dx.doi.org/10.22394/0869-5377-2017-1-135-160>.

[71] Supra, Abate p. 2

[72] Aldo Leopold, 'A Land Ethic' in Aldo Leopold (eds), *A Sand County Almanac: And Sketches Here and There* 14, 204 (Wilderness 1989).

[73] McDonald (n 12) 80.

For decades, space colonisation has been the subject of science fiction literature and speculation, but it has also piqued the curiosity of many space agencies, private corporations and academia. In the New Space era, space colonisation is considered by space actors as a feasible and desirable goal for humankind.

There is no absolute consensus on the definition of space colonisation, as some scholars include space tourism and commercial activities in it,[74] while others use it to refer to space exploration and exploitation in general.[75] However, most of the academia interprets space colonisation as the establishment of human settlements on celestial bodies,[76] without necessarily referring to a large-scale movement of human populations. Fasan makes a distinction though between permanent international settlements and temporary ones that are used as a space station,[77] while Kerkonian distinguishes settlements from colonies, arguing that settlements are self-sufficient, while colonies support Earth and at the same time rely on the latter for supplies and other kinds of assistance.[78] For the purpose of this thesis, I will use the terms colonisation and settlements interchangeably, referring to permanent human habitats in outer space, either self-sufficient or not. However, in the early stages of such projects humans might be able to stay in the extraterrestrial base only for short periods of time.

Since the 20th century, scholars and scientists have been acknowledging the likelihood of such endeavours which would make humanity a multiplanet species, debating their feasibility or their ethical foundations, and discussing their potential legal implications. The majority

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[74] King James Nkum and Beida Onivehu Julius, 'Emerging Legal Issues in Sub-Orbital Flight and Colonization under International Air and Space Law' (2019) 7 Groningen Journal of International Law 37, 37 <http://dx.doi.org/10.21827/5d5141c7c5cb9>.

[75] Audra Mitchell and others, 'Dukarr Lakarama: Listening to Guwak, Talking Back to Space Colonization' (2020) 81 Political Geography 102, 104 <http://dx.doi.org/10.1016/j.polgeo.2020.102218>.

[76] Yuri Takaya & Ricky Lee, 'Space Tourism and Permanent Human Settlement: The Legal and Regulatory Issues' (2000) 43 Proclamations on the Law of Outer Space 142, 146; Szocik, Reiss (no 60) 4; Aram Kerkonian, 'The Legal Aspects of Permanent Human Settlement on Celestial Bodies' (2019) 44 Annals Air & Space Law 415, 419; George Kyriakopoulos, 'Colonies on the Moon (and/or Mars)? New Challenges for International and National Law' (2020) 63 International Institute of Space Law 169, 169 <http://dx.doi.org/10.5553/iisl/2020063002008>.

[77] Ernst Fasan, 'Human Settlements on Planets: New Stations or New Nations' (1994) 22 Journal of Space Law 47, 52.

[78] Kerkonian (no 76) 419.

concludes that permanent human settlements beyond the Earth are inescapable and will manifest sooner than anticipated,[79] hence they suggest discussing when and how to establish these human habitats instead of whether to do so. Thus, most space entrepreneurs advertise Mars as humanity's new frontier to conquer,[80] as the Martian environment has some similarities to the terrestrial one.

In the New Space age, aspirations to launch humans into space have gained new momentum. Several plans have been made by numerous stakeholders — both States or international organisations, and private enterprises — to establish human habitats on Mars or the Moon. Indicatively, the US seeks to create a lunar base and eventually establish a colony on the red planet.[81] Nigeria and China have similar aspirations to be fulfilled by 2030.[82] Related ambitions have been also expressed by the Japan Aerospace Exploration Agency (JAXA), the Indian Space Research Organization (ISRO), the Russian Federal Space Agency (RFSA or Roscosmos), the CNSA[83] and the United Arab Emirates (UAE) space agency with the 'Mars

[79] Gerard O'Neill, The High Frontier: Human Colonies in Space (William Morrow and Company 1976); Takaya, Lee (no 76) 142; William Brennan Jr., 'Space Colonization and the Law' (1990) 3 Harv Journal of Law & Technology 7, 8-9; Igor Levchenko and others, 'Mars Colonization: Beyond Getting There' (2018) 3 Global Challenges 180, 180 <http://dx.doi.org/10.1002/gch2.201800062>; Kelly Smith, 'Homo Reductio: Eco-Nihilism and Human Colonization of Other Worlds' (2019) 110 Futures 31, 31 <http://dx.doi.org/10.1016/j.futures.2019.02.005>; Jackie Wattles, 'Colonizing Mars Could Be Dangerous and Ridiculously Expensive. Elon Musk Wants to Do It Anyway' (2020) <https://www.cnn.com/2020/09/08/tech/spacex-mars-profit-scn/index.html>; Brad Tabas, 'Outer Space, Expansive Sustainable Development, and the Future of the Environmental Humanities' (2021) Academia Letters 2, 2 <http://dx.doi.org/10.20935/al120>.

[80] Robert Zubrin, 'The Significance of the Martian Frontier', Ad Astra 1 (1994) <www.nss.org/settlenient/niars/zubrin-frontier.htnil>; David Valentine, 'Exit Strategy: Profit, Cosmology, and the Future of Humans in Space' (2012) 85 Anthropological Quarterly 1045 <http://dx.doi.org/10.1353/anq.2012.0073>; Richard Tutton, 'Multiplanetary Imaginaries and Utopia' (2017) 43 Science, Technology, & Human Values 518 <http://dx.doi.org/10.1177/0162243917737366>.

[81] US Department of State, 'Space Policy Directive-1, Reinvigorating America's Human Space Exploration Program' (2017) <https://2017-2021.state.gov/space-policy-directive-1-reinvigorating-americas-human-space-exploration-program/>.

[82] Rahder (no 62) 162; Namrata Goswami, *China in Space: Ambitions and Possible Conflict* 74-97 (Strategic Studies Quarterly 12/1, Air University Press 2018).

[83] Jakob Haqq-Misra, 'Can Deep Altruism Sustain Space Settlement?' in Konrad Szocik (eds), The Human Factor in a Mission to Mars: An Interdisciplinary Approach (Springer 2019).

2117' initiative.[84] Other noteworthy initiatives by international organisations are NASA's Artemis programme, whose goal is to send people to the Moon by 2024 and eventually establish permanent human settlements[85] using SpaceX's Starship rocket, and European Space Agency's (ESA) Moon village initiative in the pursuit of the creation of a lunar base.[86] In the private sector, Elon Musk with his SpaceX is in the saddle, followed by Jeff Bezos' Blue Origin and Richard Branson's Virgin Galactic, all of which have clearly expressed their intentions of colonising the cosmos, with Musk and his long-awaited Mars colony at the forefront.[87]

In conclusion, becoming multiplanetary is an ambitious goal that has been pursued by multiple actors in the New Space era. The number of current plans to establish human settlements off-Earth shows the increasing interest of both the private sector, States and international organisations in this field. However, these endeavours also entail risks which create ethical and legal questions and challenges that humanity needs to overcome before embarking on interstellar habitation.

3.2. Space settlements as a proposed survival strategy and other pro-arguments

In science fiction, space colonisation has often been motivated by a hostile Earth in light of an irrevocable planetary disaster. Not surprisingly, current developments in the space sector follow the same narrative to justify their multiplanetary visions.

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[84] James Dartnell, 'Abu Dhabi Police Launches 2057 Plan' (2017) <www.tahawultech.com/news/abu-dhabi-police-launches-2057-plan/>; Rahder (no 62) 160; Alexander Martin, 'Mars: Second of Three Missions to Reach the Red Planet Today - Here's What You Need to Know' (2021) <https://news.sky.com/story/mars-second-of-three-missions-to-reach-the-red-planet-today-heres-what-you-need-to-know-12208547>.

[85] NASA, 'What Is Artemis?' (2019) <www.nasa.gov/what-is-artemis>.

[86] Jake Parks, 'Moon Village: Humanity's First Step toward a Lunar Colony?' (2019) <www.astronomy.com/observing/moon-village-humanitys-first-step-toward-a-lunar-colony/>.

[87] Richard DalBello, 'Virgin Galactic: Creating Safe, Reliable, and Frequent Access to Space' (2017) Yearbook on Space Policy 167, 167-174 <http://dx.doi.org/10.1007/978-3-7091-4860-0_5>; Mike Wall, 'Elon Musk Is Still Thinking Big with SpaceX's Starship Mars-Colonizing Rocket. Really Big' (2020) <https://www.space.com/elon-musk-starship-spacex-flights-mars-colony.html>; SpaceX, 'SpaceX, Mars and Beyond The Road to Making Humanity Multiplanetary' (2023) <www.spacex.com/human-spaceflight/mars/>; Blue Origin, 'Blue Moon' (2023) <www.blueorigin.com/blue-moon>.

In the private sector in particular, scenarios of colonising celestial bodies are presented as a survival strategy to rescue humankind from the critical consequences of climate change. Fleeing Earth is often displayed as a necessity because, even if global warming does not lead to our extinction, extraterrestrial threats will lead to the same result. Physicist and cosmologist Stephen Hawking was actively supporting this view, warning people that Earth will not be able to sustain humankind for long.[88] A large part of the academia has embraced this thought,[89] considering space colonisation as a backup plan, crucial to ensure human persistence, diminish the fear of annihilation and alleviate our existential anxiety. Furthermore, it is argued that overpopulation and depletion of Earth's resources could also lead us to colonise the cosmos.[90] Ironically, although presented as an escape plan from climate change, space colonisation will cause further environmental degradation. Moreover, extraterrestrial colonisation is not as necessary as private entrepreneurs claim it to be; in fact, it is a choice. Musk wants to realise his vision using the method of terraforming, a geo-physical engineering that will make Mars suitable for humans. However, 'for the foreseeable future it will always be easier to "terraform" Earth, so that we may survive here, than to modify other planets.'[91] Besides, it is widely argued that the

[88] EcoWatch, 'Stephen Hawking: 'I Am Convinced That Humans Need to Leave Earth'' (2017) <https://www.ecowatch.com/stephen-hawking-leave-earth-2446264918.html>; Eliza Barclay, 'Stephen Hawking's Warning: It's Time to Get the Hell off Planet Earth' (2017) <www.vox.com/science-and-health/2017/6/20/15836426/stephen-hawking-colonize-other-planets>; Gael Fashingbauer Cooper, 'Stephen Hawking: Earth Could Be 'ball of Fire' in 600 Years' (2017) <www.cnet.com/science/stephen-hawking-earth-ball-of-fire-600-years-tencent-we-summit-beijing/>.

[89] Radford Byerly Jr, 'The commercial/industrial uses of space' in Eugene Hargrove (eds), *Beyond Spaceship Earth: Environmental Ethics and the Solar System* 91 (1987); Seth Baum, 'Cost–Benefit Analysis of Space Exploration: Some Ethical Considerations' (2009) 25 Space Policy 75, 77 <http://dx.doi.org/10.1016/j.spacepol.2009.02.008>, 77; Marko Kovic,'Risks of Space Colonization" (2021) 126 Futures 102, 102 <http://dx.doi.org/10.1016/j.futures.2020.102638>; SV Krichevskiy, 'Space Colonization: Problems and Prospects' (2012) 11(1) Философия И Космология 135,137; James Schwartz, 'What do we need to ask before settling space?' (2021) 74(4) Journal of the British Interplanetary Society 140, 142; Maurizio Balistreri and Steven Umbrello,'Space Travel Does Not Constitute a Condition of Moral Exceptionality. That Which Obtains in Space Obtains Also on Earth!' (2022) 71 Medicina e Morale 311, 320 <http://dx.doi.org/10.4081/mem.2022.1213> ; Kerkonian (no 76) 428; Smith (no 79) 31.

[90] Joseph Pelton, *The New Gold Rush: The Riches of Space Beckon!* 91 (Copernicus 2017).

[91] Robert Sparrow, 'Terraforming, Vandalism and Virtue Ethics' in Jai Galliott (ed), *Commercial Space Exploration: Ethics, Policy and Governance* 163 (1st ed, Routledge 2015).

true motives behind these initiatives are capital, greed and egos or, best case scenario, inquisitiveness and romanticism towards an ideal future.[92]

Another frequent argument pro-colonisation is often humans' duty to preserve humankind and morality itself[93], a purely anthropocentric idea. Morality is not humans' exclusive and absolute domain; it is a phenomenon that constantly evolves and depends on culture, religion, even on personal preferences. Even other-than-human animals have shown signs of morality, and we cannot rule out the possibility of extraterrestrial beings carrying moral values too.[94] Lastly, proposals to inhabit the cosmos claim to provide an alternative solution to anthropogenic climate change[95] and the disastrous human impacts on the environment, as well as an escape from threatening events such as nuclear warfare or pandemics.[96] What these assertions fail to acknowledge is that all the above-mentioned implications were gradually caused by human actions, which leads us to the positive conclusion that humans will repeat the same mistakes in the process of inhabiting other planets blinded by the myth of endless resources, and the common fallacy that they can reverse the exploitative and destructive human narrative on a whim. Humans have been characterised, according to statistics, as the 'deadliest species to ever roam the planet'.[97] Moreover, inhabiting other planets does not provide a solution to environmental

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[92] Rayna Slobodian, 'Selling Space Colonization and Immortality: A Psychosocial, Anthropological Critique of the Rush to Colonize Mars' (2015) 113 Acta Astronautica 89, 89 <http://dx.doi.org/10.1016/j.actaastro.2015.03.027>; Paul Wieland, *Crossing the Threshold: Advancing into Space to Benefit the Earth* (Threshold 2020 Press, 2010).

[93] Kelly Smith and Keith Abney, 'Human Colonization: A World Too Far?' (2019) 110 Futures 1, 4 <http://dx.doi.org/10.1016/j.futures.2019.02.003>.

[94] Gonzalo Munévar, "Ethical Obligations Towards Extraterrestrial Life" (2020) 10 Philosophy Study <http://dx.doi.org/10.17265/2159-5313/2020.03.003>, 198.

[95] Szocik, Reiss (no 60) 5.

[96] Baum (no 89) 77.

[97] Adam Vaughan, 'Humans Creating Sixth Great Extinction of Animal Species, Say Scientists' (2015) <www.theguardian.com/environment/2015/jun/19/humans-creating-sixth-great-extinction-of-animal-species-say-scientists>.

degradation, it just relocates the problem.[98] Naturally, this brings us to an inevitable inference: careless on Earth, careless everywhere. On that note, eco-nihilists argue that unless humans learn to take proper care of Earth and prove that they can respect the environment, they deserve extinction.[99] This view provides some valid points; however, one should not neglect the considerably heavier responsibility corporations and wealthy nations historically hold for the environmental degradation, in accordance with the principles of climate justice.

3.3. Ethical dilemmas and potential human rights violations

This section will examine the ethical considerations arising from the aspirations of space colonisation, as well as potential infringements of human rights that will be of concern to the international community. Space habitation poses fundamental ethical dilemmas according to space ethics, a young field of inquiry but of great significance. With the ever-increasing development of technology, numerous questions of morality arise, while the enjoyment of basic human rights is threatened.

Firstly, building on from the view held by Marino on our species' track record on Earth,[100] it is evident that humans are not ready to complete a successful colonisation of other planets, not in terms of technological feasibility – which, on the one hand, might be true but it is out of the scope of this thesis – but in terms of moral capabilities and cultural base. Humanity has caused serious damage to the Earth. If we consider, for instance, climate change, human rights abuses, the destruction of ecosystems, the depletion of natural resources, colonialism, wars and overpopulation, we can easily conclude that humans will repeat the same mistakes in outer

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[98] Paul Peeters, 'Why Space Tourism Will Not Be Part of Sustainable Tourism' (2018) 43 Tourism Recreation Research 540, 540-3 <http://dx.doi.org/10.1080/02508281.2018.1511942>, cited in Jennifer Frost and Warwick Frost, 'Exploring Prosocial and Environmental Motivations of Frontier Tourists: Implications for Sustainable Space Tourism' (2021) 30 Journal of Sustainable Tourism 2254, 2265 <http://dx.doi.org/10.1080/09669582.2021.1897131>.

[99] Smith (no 79) 31-32. For more information on eco-nihilism, see Wendy Lynne Lee, Eco-Nihilism: The Philosophical Geopolitics of the Climate Change Apocalypse (2017).

[100] Lori Marino, 'Humanity Is Not Prepared to Colonize Mars' (2019) 110 Futures 15 <http://dx.doi.org/10.1016/j.futures.2019.02.010>.

space. Takemura highlighted the importance of this point of view especially with regard to its environmental aspect.[101] Poverty, racism and class difference will persist. However, another angle on this debate suggests that humankind will advance socially and culturally[102] and, thus, will be able to learn from prior missteps. Nevertheless, all the evidence so far hardly convinces us that such a change will take place in the near future. In any case, assuming we are technologically capable of relocating to another planet, we can certainly use similar means to reverse the tremendous effects we have caused on Earth. Secondly, the term ‘colonisation’ has a negative connotation and is historically and culturally linked to vile practices of the West, subjugating populations and achieving dominance over other nations. The name ’colony’ conjures up negative historical and cultural associations of oppression, exploitation, and imperial power dominance. As a result, using the more neutral term ’settlement’ seems preferable.[103] The terminology used reflects the ethical and political ramifications of inhabiting other worlds as well as the possibility of interactions with extraterrestrial life forms. The potential lack of such interactions does not support the colonial language utilised in prior instances of human expansion.[104] It would also be naive to neglect the fact that, throughout the early years of colonialism, Native Americans were not always seen as human;[105] they were often described by settlers as non-human and perceived as beasts or with no soul.[106]

Furthermore, space colonisation, although often presented as being in agreement with the interests of humanity, will benefit only a tiny percentage of the Earth’s population. For people

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[101] Noriyoshi Takemura, “Astro-Green Criminology: A New Perspective against Space Capitalism Outer Space Mining May Make the Same Mistakes in Space as We Have on Earth” (2019) 40 Toin University of Yokohama Research Bulletin 11, 12.

[102] Szocik, Reiss (no 60) 150.

[103] Kerkonian (no 76) 420; Galliott (no 91) 163. That being said, in this thesis the term ’colonisation’ will be used interchangeably with the term ’settlements’ to highlight these negative connotations.

[104] Alexandra Calanchi and others, ‘An Eco-critical Cultural Approach to Mars Colonization’ (2017) Forum for World Literature Studies 9(2), 206; cf. Stewart Brand, ’The Sky Starts at Your Feet' in Stewart Brand (eds) *Space Colonies* (Whole Earth Catalog 1977).

[105] Calanchi and others (no 104) 206.

[106] Calanchi and others (no 104) 206; RE Mackay, J Feagin ’’Merciless Indian Savages‘: Deconstructing Anti-Indigenous Framing‘ (2022) 8(4) Sociology of Race and Ethnicity 518–533 <https://doi.org/10.1177/23326492221112040>.

striving to fulfil their basic needs, such a plan appears distant and inaccessible. Traphagan argues that space colonisation is solely an ambition of Western white, primarily male, intellectual and financially privileged elites.[107] To further strengthen this argument, he gives the example of Buddhists, who would be opposed to the above-mentioned practice since their philosophy is far from the Western conception of self- centeredness.[108] Along the same lines, these initiatives, viewed from an eco-feminist, environmental justice or political ecology perspective[109] would not have the same reception and luck. Moreover, questions on the bioethics of human enhancement will arise, since there is a high likelihood that the first settlements on the red planet will necessitate genetically enhanced astronauts.[110] Regarding human reproduction in space, ethical inquiry will focus on a more liberal view of the right to abortion,[111] as well as the conditions under which reproduction in space will be justified.[112] In these ethical dilemmas, the rights of the child must be taken into consideration, to safeguard their right to health and well-being. In addition, Szocik introduces the quality-of-life ethics into the discussion, arguing that, when inhabiting other planets, a minimal standard of living should be provided.[113] Space colonisation may be presented as a last resort to ensure the long-term survival of humankind and prevent its extinction but, to characterise such practice as moral, fundamental rights must be safeguarded and a particular level of comfort and health should be guaranteed in outer space. Hence, if humans rush into their space settlement operations in such an inhospitable environment, they may end up suffering from various illnesses and conditions almost immediately, due to the

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[107] John Traphagan, 'Which Humanity Would Space Colonization Save?' (2019) 110 Futures 47 <http://dx.doi.org/10.1016/j.futures.2019.02.016>; See also Schwartz and others (no 89) 5; Rahder (no 62) 162.

[108] Traphagan (no 107) 48.

[109] Konrad Szocik, 'Space Bioethics: Why We Need It and Why It Should Be a Feminist Space Bioethics' (2020) 35 Bioethics 187 <http://dx.doi.org/10.1111/bioe.12803>; JS Schwartz, T Milligan, 'Some Ethical Constraints on Near-Earth Resource Exploitation' in C Al-Ekabi and others (eds), *Yearbook on space policy 2015: Access to space and the evolution of space activities* 227–39 (Springer 2017); Linda Billings, 'How Shall We Live in Space? Culture, Law and Ethics in Spacefaring Society' (2006) 22 Space Policy 249 <http://dx.doi.org/10.1016/j.spacepol.2006.08.001>.

[110] Balistreri, Umbrello (no 89) 313; Szocik, 'Feminist space bioethics' (no 109) 188.

[111] Szocik, Feminist space bioethics (no 109) 188.

[112] Levchenko and others (no 79) 5.

[113] Konrad Szocik, 'Humanity Should Colonize Space in Order to Survive but Not with Embryo Space Colonization')2021) International Journal of Astrobiology 1, 320 <http://dx.doi.org/10.1017/s1473550421000148>.

immense differences in the climate and atmosphere. Apart from that, the mental health and psychology of (especially the first) settlers will be affected.[114] Even their right to life is at stake, as the first settlers are likely to survive only slightly more than two months before suffocating.[115]

In addition, the amount of space debris found in multiple orbits endangers the right to safety or even the right to life in case of a collision.[116] Additionally, the increasing space initiatives by private entrepreneurs already threaten the right to the night sky, which, although still not officially recognised by an international treaty, is already included in environmental declarations. Firstly, it is indirectly recognised in Rio Declaration at principle 3, and in Stockholm Declaration[117] through the advancement of the natural environment. Secondly, the Declaration in Defence of the Night Sky and the Right to Starlight[118] acknowledges the significance of the night sky. The latter adds to human well-being by offering them tranquility, aesthetics, fulfilment and mental outlook, as well as to the stability of the natural world as a whole, by keeping the wildlife's and wilderness' main elements and functions in balance.[119] Finally, space colonisation might have destructive impacts on the environment of both outer space and the Earth, which will be closely examined in section 3.4.

3.4. Environmental consequences of space colonisation

3.4.1. General remarks on the environment of outer space and its relation to Earth

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[114] Nick Kanas, *Humans in Space: The Psychological Hurdles* 804 (Springer 2015).

[115] Jennifer Chu, 'Mars One (and Done?)' ((2014) <https://news.mit.edu/2014/technical-feasibility-mars-one-1014>.

[116] Supra Ireland-Piper & Freeland - HRs, space and corporate accountability 18; See also Steven Freeland and Lucy Stewardson, 'From Confrontation to Cooperation, Or How Space Debris Has Influenced Space Law' (2019) 44 Annals Air & Space L 379, 390.

[117] See principle 3.

[118] Declaration in Defence of the Night Sky and the Right to Starlight [hereinafter La Palma Declaration], STARLIGHT INITIATIVE (2007), <www.archeoastronomy.org/downloads/starlightdeclarationc.pdf>.

[119] Alyssa Nelson, 'The (Second) Race to Space: A Human Rights Analysis of Rapid Space Innovation' (2021) 50 Ga J Int'l & Comp L 254, 274 and the corresponding notes.

Examining space colonisation through an ecocentric lens, the major issue that needs to be addressed is the devastating environmental consequences that will be caused. Before proceeding to the examination of the potential environmental implications that such plans might have, a few clarifications are needed.

Firstly, it is important to explain why outer space is considered an environment. Most definitions describe the environment as 'the whole set of biotic (living) or non-biotic elements surrounding an individual or a species, which forms its living frame and provides him with the resources necessary for its survival.'[120] Mayence points out that, based on this definition, one would characterise space as an 'anti-environment',[121] as space can be a hostile and unhabitable domain for humans. Mayence continues to argue that the notion of 'environment' does not necessarily presuppose the existence of life, and highlights that the preservation of outer space could be an end itself.[122] Indeed, from an ecocentric angle outer space is considered as an environment despite the potential absence of life. One also needs to bear in mind that the outer space environment in the human thought is constructed in a relational manner: by distinguishing it from Earth, the human species and its hypothetical non-existence in outer space, or by projecting human aspirations and threats onto it.[123] Our knowledge of the cosmos is still narrow, restricted by our understanding of the world through our senses, and the limits on our ability to understand and interpret our findings. In this sense, a better understanding of the space environment is crucial before we even think of expanding in the universe. One should also carefully consider the fragility of the extraterrestrial environment; reversing the environmental degradation in outer space will be proven to be extremely hard,[124] if not impossible.

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[120] Jean-Francois Mayence, 'Article IX of the Outer Space Treaty and the Concept of Planetary Protection: Toward a Space Environment Law' (2010) 53 Proc Int'l Inst Space L 697, 697.

[121] ibid 697.

[122] ibid 698.

[123] Supra Klinger 7

[124] Martin, Freeland (no 57) 328.

Subsequently, the question on the demarcation of outer space arises. It is usually supported that the limits of outer space are the upper atmosphere and the lower lithosphere,[125] although indigenous peoples conceive these limits differently.[126] In general, there is no consensus on the boundaries of outer space though. Humans tend to distinguish between the environment of Earth from the one of outer space, reinforcing a dualism that provides justifications for the plans to colonise the cosmos without having to face the subsequent environmental and ethical challenges. However, we are already part of space, and there is no possibility to externalise the destructive environmental implications our actions will cause.[127] Scholars agree that space activities are hazardous per se,[128] meaning that they will inevitably cause negative environmental implications. As a result, the dreadful consequences of human aspirations will inevitably come to haunt them in the near future.

3.4.2. Main environmental consequences

Having provided these explanatory remarks, this section will now demonstrate the main environmental implications that space colonisation is likely to cause. They can be observed both in outer space and on Earth; the global environment consists of interrelated subsystems, and any harm to one of them can have implications on the others.[129] The list is certainly not exhaustive, yet it focuses on the major issues that need to be addressed; the latter are space debris, biological

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[125] Klinger (no 68) 9.

[126] Cristina Inoue and Paula Moreira, ’Many Worlds, Many Nature(s), One Planet: Indigenous Knowledge in the Anthropocene‘ (2016) 59 Revista Brasileira de Política Internacional 6 <http://dx.doi.org/10.1590/0034-7329201600209>.

[127] Christy Collis, ’Territories beyond Possession? Antarctica and Outer Space‘ (2017) 7 The Polar Journal 287 <http://dx.doi.org/10.1080/2154896x.2017.1373912>; Sylvia Ospina, 'Outer Space: Common Heritage or Common Junkyard of Mankind' (1987) 30 Proc on L Outer Space 228, 230; Elizabeth Mendenhall, ’Treating Outer Space Like a Place: A Case for Rejecting Other Domain Analogies‘ (2018) 16 Astropolitics 97 <http://dx.doi.org/10.1080/14777622.2018.1484650>.

[128] Sergio Marchisio, 'Protecting the Space Environment' (2003) 46 Proc on L Outer Space 9, 9; Xu (no 56) 2; Supra Cocca and others (no 8) 338.

[129] Bianchi 237-238 in Francesco Francioni, Tullio Scovazzi (eds.), I*nternational Responsibility for Environmental Harm* (Kluwer Law International 1991); See also HE Qizhi, 'Environmental Impact of Space Activities and Measures for International Protection' (1988) 16 J Space L 117, 120.

contamination, emissions of various substances and the use of nuclear power sources (NPS) in space.

An attempt to create human settlements on celestial bodies would potentially harm the environment at all stages of its execution. Kuskuvelis demonstrates that environmental impacts can arise even from the establishment of a space facility or the launching phase.[130] Additionally, for a permanent space settlement to be established, it has to go through several stages; every action taken to get humankind one step closer to this goal will cause environmental consequences,[131] from the first landing until the settlement becomes self-sustaining. One of the major challenges that humanity already faces is space debris. There is no consensus on the definition of space debris, nor can they be found in any of the main space treaties or other binding documents on the protection of the environment. The UN Committee on the Peaceful Uses of Outer Space (COPUOS) Guidelines define space waste as 'all man-made objects, including fragments and elements thereof, in earth orbit or re-entering the atmosphere, that are non-functional',[132] however this definition is certainly non-binding. The above-mentioned guidelines had moral and political value though,[133] and many States comply with them in light of the weaknesses of the space treaties in this field. Space junk might come from different origins[134] and can appear in multiple orbits, but mostly in the Lower Earth Orbit (LEA). According to ESA,[135] there are currently more than 29.000 space debris larger than 10cm in orbit, and more than 670.000 space debris objects that are larger than 1cm. No matter their size, space waste can

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[130] Ilias Kuskuvelis, 'Functional Approach and beyond: Towards a Functional Aerospace Environmental Regime' (1987) 30 Proc on L Outer Space 330, 330-331.

[131] Manfred Hintz, 'Environmental Aspects of Settlements on the Moon and Mars Planetary Protection' (1991) 34 Proc on L Outer Space 59, 59-60.

[132] Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2021) A/AC.105/C.1/L.260, para 1.

[133] Fabio Tronchetti 'Soft law' in Christian Brünner and Alexander Soucek (eds), *Outer Space in Society, Politics and Law, vol 8* 630 (Springer 2011).

[134] Isabella Diederiks-Verschoor, *An Introduction to Space Law '* (2nd ed., Kluwer Law International 1999); Thierry Senechal, *Orbital Debris: Drafting, Negotiating, Implementing a Convention* (Massachussets Institute of Technology 2007).

[135] ESA, 'How Many Space Debris Objects Are Currently in Orbit?' (2023) <www.esa.int/Space_Safety/Clean_Space/How_many_space_debris_objects_are_currently_in_orbit>.

be dangerous in cases of collision with a spacecraft because of their high speed. A potential collision would threaten astronauts' lives and result in even more space debris in orbit, which will endanger anything that enters this orbit.[136] No human lives have been lost yet, but 'manoeuvring' spacecrafts to prevent impacts with space junk is already a prevalent practice.[137] Every collision with space debris requires a considerable amount of energy; thus, a crash of debris with NPS would result in extensive radiological pollution[138]. Lastly, an ominous prediction that will sooner or later become a reality is the Kessler effect[139]. This scenario, also called 'cascade effect'[140], demonstrates that, when the quantity of debris in orbit reaches a certain threshold, they will continue increasing rapidly due to their constant collisions with other space debris in orbit. Thus, space waste threats both the global environment and the human rights to life, health and safety.

Another critical environmental issue is biological forward and back contamination. Forward contamination is the introduction of elements of biological substances in outer space, while back contamination is the transfer of extraterrestrial material into Earth's environment, both caused by human activity.[141] Forward contamination is considered more dangerous, as the space environment is fragile, unique, and still unknown to us to a large extent. Undeniably, if Mars or other celestial bodies have indigenous life forms, contamination might produce destructive and irreversible effects upon them. Sterns and Tennen warn that such a result would

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[136] Francis Lyall and Paul Larsen, *Space Law: A Treatise 2nd Edition* 305 (Routledge 2018) <http://dx.doi.org/10.4324/9781315610139>; Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future* 36 (Brill 2008).

[137] PK McCormick, 'Space Debris: Conjunction Opportunities and Opportunities for International Cooperation' (2013) 40 Science and Public Policy 801, 802 <http://dx.doi.org/10.1093/scipol/sct028>.

[138] Francioni (no 129) 238.

[139] cf. Donald Kessler and Burton Cour-Palais, 'Collision Frequency of Artificial Satellites: The Creation of a Debris Belt' (1978) 83 Journal of Geophysical Research 2637, 2637 <http://dx.doi.org/10.1029/ja083ia06p02637>.

[140] Francioni (no 129) 239.

[141] Stephen Gorove, 'Pollution and Outer Space: A Legal Analysis and Appraisal' (1972) N.Y.U. J. International Law & Policy 5, 55-56.

put future scientific research at risk;[142] however, this is solely an anthropocentric ambition. Humans must be also concerned about harming the extraterrestrial life that celestial bodies might have, not for their own scientific aspirations but also for microorganisms' sake. Kovic also argues that damaging indigenous life forms will have future moral consequences.[143] It is true that extraterrestrial intelligence has yet to be found, but humans cannot rule out this possibility, especially considering that life on Earth also emerged from microbes, and that some kinds of microbes can survive under extreme conditions. Some efforts have been made to avoid biological contamination, principally through the Committee on Space Research (COSPAR) Planetary Protection Policy,[144] as amended in March 2011, followed by NASA's Policy Directive[145] and ESA's Planetary Protection Policy,[146] compliant with the Committee's principles. However, transferring undesirable biological elements to other planets will be inevitable even with extreme caution because of humans' biological functions and the impossibility to sterilise all components of a spacecraft.[147]

Furthermore, chemical releases and emissions of other substances will further harm the environment. These substances include chlorine, aluminum and chlorofluorocarbons, mostly present in the fuels of space vehicles and emitted during their launch or later. Evidently, such effluents will alter extraterrestrial environments,[148] as well as further pollute the Earth's environment. Already in 1976, Christol was highlighting that the depletion of the stratospheric ozone layer was caused, inter alia, by the emissions of spacecrafts.[149] The latter might soon

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[142] PM Sterns, LI Tennen, 'Principles of Protection of the Outer Space Environment in the Corpus Juris Spatialis' (1987), 173.

[143] Kovic (no 89) 14.

[144] COSPAR, 'Policy on Planetary Protection' (2020).

[145] N_PD_2230_0001 (2016).

[146] ESA/C(2007)143.

[147]International Academy of Astronautics (IAA), 'Cosmic Study 'Protecting the Environment of Celestial Bodies'' (2010) 50.

[148] Frost (no 98) 2256.

[149] Carl Christol, 'Stratospheric Ozone, Space Objects and International Environmental Law' (1976) 4 J Space L 23, 24.

become the biggest source of carbon dioxide released into the atmosphere,[150] as space activities continue increasing rapidly. Lastly, if a space settlement becomes self-supporting, the system established to support human needs will inevitably release carbon and other substances.[151]

Finally, tremendous hazards might be caused using NPS in space. NPS are often used for space vehicles because they offer advantages such as lasting power and longevity.[152] Nevertheless, their effects can be proven detrimental, particularly regarding the subsequent radiological contamination. NPS, in case of an accident, will release radioactive substances, which will harm both the environment[153] and human beings who will be exposed to 'external radiation and internal radiation from inhalation or ingestion'.[154] Hence, the human right to health will also be directly endangered. Examples supporting this view are the Starfish explosion, which created a radiation zone,[155] and the collision of the Russian satellite Cosmos in 1978, which released radioactive substances into the Earth's atmosphere while re-entering.[156]

In conclusion, it is clear that space colonisation will lead to further degradation of the environment. Moreover, humans should not carry on with the myth of endless resources because scholars and scientists already warn humanity that resources are limited.[157] Thus, humans should reconsider before making the next step towards the final frontier.

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[150] Mark Piesing, 'The Pollution Caused by Rocket Launches' (2022) <www.bbc.com/future/article/20220713-how-to-make-rocket-launches-less-polluting>; See also Anne-Sophie Martin, Steven Freeland, 'A Round Trip to the Stars?: Considerations for the Regulation of Space Tourism', (2022), 47 (2) Air and Space Law 261, 280 <https://doi.org/10.54648/aila2022014>.

[151] Randall Briggs and Albert Sacco Jr., 'Environmental Considerations and Waste Planning on the Lunar Surface' in WW Mendell (eds), *Lunar Bases and Space Activities of the 21st Century* 427 (Houston 1985).

[152] David Tan, 'Towards a New Regime for the Protection of Outer Space as the 'Province of all Mankind,'' (2000) 25 Yale Journal of International Law 146.

[153] Francioni (no 129) 238-239; Tan (no 152), 7.

[154] UN GAOR, Question Relating to the Use of Nuclear Power Sources in Outer Space, UN Doe. AIAC 1051220 (1978).

[155] Paul Dembling, Swadesh Kalsi, 'Pollution of Man's Last Frontier: Adequacy of Present Space Environmental Law in Preserving the Resource of Outer Space' (1973) 20 Netherlands International Law Review 125, 129 <http://dx.doi.org/10.1017/s0165070x00021422>.

[156] He Qizhi, 'Towards a New Regime for the Use of Nuclear Power Sources in Outer Space' (1996) 14(2) Journal of Space Law 97.

[157] Joshua Easterson, 'You Can Lead an Astronaut to Water..: Prospects for Legal Use and Water Rights on the Moon and Other Celestial Bodies' (2010) 53 Proc Int'l Inst Space L 48, 48.

3.4.3. Terraforming

Special mention should be made to the process of terraforming, a process of changing an extraterrestrial environment to fit our needs as human beings. Also called 'planetary ecosynthesis' — a term more accurate according to McKay and Marinova,[158] since the compound 'terra' refers to Earth, — this practice is defined as a process of geo-physical engineering to other celestial bodies, aiming at making them habitable for humans, assisting the execution of colonisation plans.[159]

Terraforming has often appeared in science fiction novels, but nowadays it constitutes a legitimate goal of space enthusiasts such as Elon Musk. The astronomer Carl Sagan was the first one to publish a scientific paper on this topic[160]. Musk has declared that he plans to terraform Mars by detonating 3000 nuclear bombs per day for an uncertain period of time until the red planet becomes human-friendly[161]. This will be realised through the creation of 'global warming' conditions[162], which will finally change the Martian atmosphere, temperature and pressure. This practice has been characterised as inspiring[163] or even advisable in certain conditions[164]; however, one does not need to go far to imagine the detrimental consequences it would have for the environment. Terraforming will harm potential indigenous life forms and will massively

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[158] Christopher McKay and Margarita Marinova, 'The Physics, Biology, and Environmental Ethics of Making Mars Habitable' (2001) 1 Astrobiology 89, 91 <http://dx.doi.org/10.1089/153110701750137477>.

[159] Supra Sparrow 161; Robert Klee, 'Human Expunction' (2017) 16 International Journal of Astrobiology 379, 385 <http://dx.doi.org/10.1017/s1473550417000039>.

[160] Carl Sagan, The planet Venus. Recent observations shed light on the atmosphere, surface, and possible biology of the nearest planet' (1961), Science Vol 133, Issue 3456, 849-58 <10.1126/science.133.3456.84>.

[161] Robert Walker, 'Nukes Can NEVER Terraform Mars - A Million 100 Megaton Nukes Can't Do It - Elon Musk's Sci. Fi Teeshirts' (2019) <www.science20.com/robert_walker/nukes_can_never_terraform_mars_a_million_100_megaton_nukes_cant_do_it_elon_musks_sci_fi_teeshirts-240782>; Elon Musk, 'Making Life Multi-Planetary' (2018) 6 New Space 2, 11 <http://dx.doi.org/10.1089/space.2018.29013.emu>.

[162] Martyn Fogg, *Terraforming: Engineering Planetary Environments* (Society of Automotive Engineers 1995).

[163] ibid 490.

[164] James Schwartz and Tony Milligan (eds), *The Ethics of Space Exploration* 13 (Springer 2016).

reinforce the emissions of chemical and radioactive substances. Even in the absence of primitive life, the extraterrestrial environment will be altered severely and irreversibly, raising ethical questions. Furthermore, releasing toxic substances with the hopes of warming up a planet to host humans is risky per se; humans cannot predict how an unknown to them environment will react and what results such actions might have.[165]

The feasibility of terraforming is debatable, with the odds not being in favour of its success. Nevertheless, it remains one of the most ambitious future goals of private enterprises who wish to inhabit the cosmos. Thus, its ethical, environmental and legal dimensions should be thoroughly discussed.

In summary, this thesis does not support space settlements' plans under current circumstances. The numerous plans to become multiplanetary appear rushed, and the motives behind them controversial. The colonisation of celestial bodies creates various ethical dilemmas and gross violations of human rights, as presented above. Moreover, it will lead to further environmental degradation, as its ecological consequences will be significant, especially in the context of our limited knowledge of the space environment. Thus, humans are not ready to proceed with their ambitions of colonising the cosmos, as the disadvantages outweigh the advantages, and the environmental destruction will be massive.

4. Cosmocentric ethics

4.1. Astroenvironmentalism

As previously discussed, space settlements will lead to further environmental degradation, both in outer space and on Earth. The major issue that needs to be addressed is the expansion of environmental ethics to provide an effective theoretical background upon which the current

[165] Paulose (no 65) 302.

legislation on space activities can evolve and be interpreted. This section will introduce the concept of astroenvironmentalism, a field which combines space ethics and environmental ethics, resulting in an interdisciplinary approach considering the plans to inhabit the cosmos.

Merging space ethics and environmental ethics was firstly thoroughly examined by Hargrove, who in his book 'Beyond Spaceship Earth'[166] presented a series of essays on the ethical, political and social issues surrounding space activities and potential plans of colonisation, with a focus on the environment. Astronauts were also among the first who included outer space and celestial bodies in nature, being classified among the first naturalists.[167] Astroenvironmentalism requires deconstructing the myth of human supremacy that is poisoning our current relationship with the global environment. In this context, space is considered as a 'wilderness to protect, not a frontier to exploit'.[168] Critics often argue that the technologies humans use to access outer space and establish space stations will eventually benefit Earth and contribute to our well-being.[169] However, Cockell wonders why we should engage in costly activities which further pollute the environment and place human lives, other-than-human animals and non-living entities at risk, only to achieve something that we could have achieved spending less money and investing on Earth's protection.[170] Astroenvironmentalism also supports planetary protection, arguing for the protection against biological contamination. Ethical questions on the potential discovery of life beyond Earth are becoming more urgent. This will prove to be challenging if one considers the way humans treat other-than-human animals on Earth, so an expansion of our ethical horizon seems critical. On that note, scholars argue that using Rawls' veil of ignorance as a thought experiment could lead humans in the right direction

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[166] Eugene Hargrove (ed), *Beyond Spaceship Earth: Environmental Ethics and the Solar System* (Sierra Books 1987).

[167] Ryder Miller, 'Astroenvironmentalism: The Case for Space Exploration As An Environmental Issue' (2001) 1 (15) Electronic Green Journal, 5 <https://escholarship.org/uc/item/2d37b8cx>.

[168] ibid 2.

[169] Charles Cockell, *Space on Earth: Saving our World by Seeking Others* 45 (Macmillan 2006).

[170] ibid 46.

and compel them to reconsider their ethical standards[171] and their relationship with other living entities.

However, a weakness of such an approach is that it is consumed with a life-bias.[172] Bioethics, or ethics of life, are central in astroenvironmentalism; unless a celestial body is known to have life, it shall not be protected, and procedures like terraforming could easily be justified. Based on this variation of bioethics, terraforming is even characterised as a 'good deed'[173] or a 'betterment' of a planet,[174] if it is indeed devoid of life, as such practice would enhance the planet's biodiversity and increase its uniqueness. This view can often be anthropocentrism in disguise, since it supports that the conservation of nature is important because it provides ecosystem services that are necessary for human welfare. Thus, even though humans are not explicitly mentioned, their needs are still in the centre, and environmental protection is solely a by-product. Lastly, astroenvironmentalism might also be considered as weak anthropocentrism, according to which human beings have a moral obligation to protect and preserve the environment as their well-being is directly related to nature; this variation recognises the intrinsic value of other-than-human animals, but not in the same level as humans, reinforcing dichotomies.

As it is evident, astroenvironmentalism introduces essential elements in space law in the New Space era. It enables humans to view their plans for extraterrestrial settlements through the lens of environmental ethics, which calls for reconsidering such practices to avoid past mistakes. Nevertheless, humans must make sure they do not fall into the life-bias trap.

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[171] John Rawls, *A Theory of Justice* (Belknap Press 1971).

[172] See James Schwartz, 'Where No Planetary Protection Policy Has Gone Before' (2018) 18 International Journal of Astrobiology 353, 354 <http://dx.doi.org/10.1017/s1473550418000228>, and the corresponding footnotes for examples.

[173] Saara Reiman, 'Is Space an Environment?' (2009) 25 Space Policy 81. 82 <http://dx.doi.org/10.1016/j.spacepol.2009.03.005>.

[174] Martyn Fogg, 'The Ethical Dimensions of Space Settlement' (2000) 16 Space Policy 205, 209 <http://dx.doi.org/10.1016/s0265-9646(00)00024-2>.

4.2. Space jurisprudence and cosmocentric ethics

Having established that astroenvironmentalism could offer an enlightening perspective to human activities off-Earth, it is important to note that not all variations of astroenvironmentalism coincide with bioethics. This section seeks to argue in favour of cosmocentrism, an area of astroenvironmentalism which has borrowed and incorporated the main elements of ecocentrism, as briefly described in sections 1.3. and 2.4.

Cosmocentrism, also known as astrocentrism, is a relatively new field of astroenvironmentalism that places the cosmos in the centre.[175] It seeks to avoid dualism and acknowledges that both other-than-human animals and abiotic factors of an ecosystem have inherent value, either as a whole or individually. The philosophical expression of cosmocentrism is space jurisprudence which, in proportion to Earth jurisprudence, recognises this intrinsic value and measures value objectively. This philosophical approach still places value on other-than-human animals but is also concerned with inanimate elements. Cosmocentrism is more far-sighted compared to anthropocentrism,[176] as it takes into account the chaos that humankind has already caused on Earth, enabling one to predict and prevent another massive destruction of the global environment. One could argue that space colonisation differs from past colonial practices on Earth, as celestial bodies are potentially lifeless, so there is no species to occupy. However, terraforming, for instance, would not agree with cosmocentrism, as celestial bodies would be protected under this philosophical view even if they are devoid of life. Moreover, both ecocentrism and subsequently cosmocentrism have been criticised as ‘misanthropic’ and ‘totalitarian’.[177] Needless to say, they constitute the most egalitarian environmental ethics[178], placing equal moral value to all elements. Biocentric ethics are important but incomplete, as they

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[175] Mark Lupisella, John Logsdon, ’Do We Need a Cosmocentric Ethic?’ (1997) American Institute for Aeronautics and Astronautics 1.

[176] ibid 5.

[177] Marti Kheel, ’The Liberation of Nature‘ (1985) 7 Environmental Ethics 135, 241-256 <http://dx.doi.org/10.5840/enviroethics19857223>.

[178] Cockell (no 169) 123.

would not protect, for instance, the highly intricate inorganic structures[179] of Mars. What is more, environmental ethicists emphasise that the focus should be on safeguarding the existing ecosystems rather than promoting them and increasing their quantity.[180] Thus, it is not considered ethical to place life on Mars, altering the planet's balance and existing systems, only to create biodiversity. Lastly, cosmocentrism offers a rights-based protection of the voiceless,[181] as it places intrinsic value on them and aims at safeguarding their rights. Hence, the protection of the rights of other-than-human animals, the rights of nature and the rights of future generations is ensured.

In conclusion, a cosmocentric ethic must be adopted and subsequently integrated into our legislation. This is the most effective way to safeguard the rights of the voiceless and preserve the global environment. Anthropocentrism has already destroyed the Earth, so a cosmocentric approach might be the only way to change the narrative and not repeat the mistakes of the past.

4.3. Intergenerational and intragenerational ethics

The environmental consequences arising from a potential space colonisation operation are strongly associated with intergenerational and intragenerational ethics, namely the protection of the rights of future generations and present developing countries, and the obligations we owe them in light of climate justice.

There is a current debate surrounding future generations as rightsholders. Before the demonstration of the contradicting arguments, a clarification is needed: for the purpose of this thesis, the term 'future generations' stands for units of hypothetical people who are not yet born and do not yet exist, namely the generations subsequent to the existing generations of humans.[182]

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[179] Supra Sparrow , 162,

[180] Karim Jebari, Anders Sandberg, 'Ecocentrism and Biosphere Life Extension' (2022) 28 Science and Engineering Ethics 49 <http://dx.doi.org/10.1007/s11948-022-00404-2>.

[181] Randall Abate, 'Climate Change and the Voiceless: Protecting Future Generations, Wildlife and Natural Resources' (2020) 39 U Tas L Rev 175, 175.

[182] Kingdom of the Netherlands, UN Elements Paper Declaration for Future Generations (2022).

From a philosophical perspective, the aforementioned term is intricately connected to the continuation of existence of humankind as an integral part of the natural environment. Future generations are distinguished from past and present generations of humans. Yet, it has been argued that our descendants may differ in multiple levels from the existent traditionally defined human species and may include various extraterrestrial species or other entities, even landscapes.[183] Other-than-human animals and lifeless entities could be included in the definition of future generations, if an ecocentric approach is followed; hence, the concept of future generations would become more inclusive and less anthropocentric, Having established this meaning, it should firstly be noted that part of academia illustrates that future generations cannot have rights since they do not exist yet. Based on the non-identity problem, also known as the 'paradox of future individuals', they raise moral questions and argue that our actions will cause different people to exist instead of those who would be born if no such intervention had taken place[184].

However, an alternative perspective illustrates that there is a moral duty to safeguard the rights of posterity, according to the principles of social justice, environmental ethics and climate justice. Most notably, Weiss argues that equality over multiple lifespans calls for ensuring fair access to the planetary resources and advantages, which requires that each generation leaves Earth in no worse shape than they found it. 'Each generation is thus both a trustee for the planet with obligations to care for it and a beneficiary with rights to use it',[185] she continues. Moreover, Elliot displays that the current generation's activities have an influence on future people's ability to exercise their rights, hence we are responsible for abstaining from actions that will harm their interests.[186] Lewis further develops this idea arguing that the tripartite human rights obligation of

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[183] William Kramer, 'Colonizing Mars—An Opportunity for Reconsidering Bioethical Standards and Obligations to Future Generations' (2011) 43 Futures 545, 550 <http://dx.doi.org/10.1016/j.futures.2011.02.006>.

[184] Anthony D'Amato, 'Do We Owe a Duty to Future Generations to Preserve the Global Environment?' (1990) 84 American Journal of International Law 190, 355 <http://dx.doi.org/10.2307/2203019>.

[185] Edith Brown Weiss, 'Our Rights and Obligations to Future Generations for the Environment' (1990) 84 American Journal of International Law 198, 200 <http://dx.doi.org/10.2307/2203020>.

[186] Robert Elliot, 'The Rights of Future People' (1989) 6 Journal of Applied Philosophy 159, 162 <http://dx.doi.org/10.1111/j.1468-5930.1989.tb00388.x>.

the state applies to future generations as well.[187] Inevitably, the rights of future generations must be considered as a core element of states' policies, not only as a moral ideal, but also as a legal obligation of present generations. Lastly, Agius raises a thought-provoking question: 'why should we bother about generations yet to be born especially when so many of the present generations are in such a miserable condition?'[188] Gündling and Inglott undeniably provide an adequate answer by connecting future generations in the developed world and present ones in the developing world, and arguing that, as allies, they have similar interests based on climate justice and the achieved level of equity in both generations is interconnected.[189]

To connect the above-mentioned arguments to space colonisation, the preservation of outer space, as 'common heritage of mankind', for future generations should be considered. As already discussed, some of the latest approaches to the climate crisis include the exploitation of extraterrestrial resources and a plan towards space colonisation; the latter will benefit only affluent individuals in the developed world, neglecting the interests of future generations and present developing regions. A rapid utilisation of space resources and a rushed colonisation of the cosmos will be an enormous mistake of humankind that posterity will blame us for, and these practices will inevitably result in the same injustices. In the context of sustainability, scholars agree that States are obliged to guarantee the preservation and safe use of outer space by future generations[190] moving towards ways of sustainable development taking into account the interests of future generations. Outer space should be preserved 'in its original pristine state, for its own

[187] Bridget Lewis, 'Human Rights Duties towards Future Generations and the Potential for Achieving Climate Justice' (2016) 34 Netherlands Quarterly of Human Rights 206, 217 <http://dx.doi.org/10.1177/016934411603400303>.

[188] Sia Santiago, André Cloot, *Framing a Vision of the World: Essays in Philosophy, Science and Religion: In Honor of Jan Van Der Veken* 251 (Leuven University Press 1999).

[189] Lothar Gündling, 'Agora: What Obligation Does Our Generation Owe to the Next? An Approach to Global Environmental Responsibility' (1990) 84 The American Journal of International Law 211; Peter Serracino Inglott, 'The Rights of Future Generations: Some Sociophilosophical Considerations' (1982) 33 Melita Theologica 4, 6.

[190] Daniel Deudney, *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity* (2020), 374.

sake and for future generations to enjoy',[191] with respect to the principles of intergenerational equity, as illustrated by Weiss, namely options, quality and access.[192] However, some scholars argue that space colonisation will contribute to the well-being of future generations; Kerkonian argues that humans will be able to transmit the species' gene from one generation to another,[193] while Kovic supports that space settlements are required for future generations to exist.[194] The latter goes on to add though that what matters is to ensure that those generations will also live lives worth living.[195] Moreover, the worsening effects of climate change will affect future generations disproportionally. As section 3.4. illustrated, space colonisation and the preparatory space activities will, for instance, further destroy the ozone layer through emitting carbon and other toxic substances into the atmosphere, while practices like terraforming include the use of nuclear energy and the release of greenhouse gases, which will further contribute to climate change. As a result, future generations will face the consequences of the current generations' actions. Besides, the negative effects of past emissions will persist for some time even if emissions are stopped immediately.[196] Clearly, the evidence highlights that space colonisation appear risky, unless present generations adjust their plans, with their obligations towards future generations as a compass. Lastly, an intragenerational ethic is directly linked to intergenerational equity. The first step towards bridging the gap between developed and developing countries is sharing the benefits of space activities, according to the wishes of developing countries[197] and the international obligations of spacefaring States. Effectively protecting the rights of future generations places a burden on developing countries and other-than-human animals, which

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[191] Bernard Schafer, 'Solid, Hazardous, and Radioactive Wastes in Outer Space: Present Controls and Suggested Changes' in Robert Wells (eds), *Law, Values, and the Environment: A Reader and Selective Bibliography* 399 (Scarecrow Press 1996).

[192] Edith Brown Weiss, 'Climate Change, Intergenerational Equity, and International Law" (2008) 9 Vermont Journal of Environmental Law 624.

[193] Kerkonian (no 76) 421.

[194] Kovic (no 89) 12.

[195] ibid 6.

[196] Lewis (no 187) 210.

[197] Jasentuliyana (no 62) 142.

continue to face the negative effects of ecologically damaging space activities,[198] a burden which developed countries are compelled to alleviate.

In conclusion, we have moral duties towards future generations, and we are obliged to hand over Earth and other celestial bodies exactly as we received them. Undeniably, intergenerational injustice has to be considered when engaging in space colonisation operations in combination with the intragenerational one, for the global community to be able to react productively when new challenges emerge; new technologies and ethical dilemmas may disclose threats to future generation's rights, to which prevention will be the key towards a safe global habitat of humankind.

4.4. Indigenous peoples' views on the environment and their connection to the sky

Indigenous peoples have long embraced ecocentric views and have adopted a way of living in harmony with nature. Several indigenous communities believe in the interconnectedness of all living and non-living things, have deep respect for nature, dismiss human superiority and support our responsibility to protect the environment. Western countries could gain priceless knowledge from indigenous communities and could benefit if they integrated indigenous views in their legislation and policies. Therefore, in the context of the space colonisation plans, it is crucial to consider indigenous peoples' relationship with the environment and their bonds with the sky.

There is no universal definition of indigenous peoples but, according to the International Labour Organisation (ILO) Convention, they are characterised as such 'on account of their descent from the populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonisation or the establishment of present state boundaries and who, irrespective of their legal status, retain some or all of their own social,

[198] Miranda Forsyth and others, 'A Future Agenda for Environmental Restorative Justice?' (2021) 4 The International Journal of Restorative Justice 17, 18 <http://dx.doi.org/10.5553/tijrj.000063>; Adrian-Paul Iliescu and others, ' Intergenerational justice in the context of developing countries' in Marcus Düwell and others (eds), *Towards the Ethics of a Green Future* 111-112 (Routledge 2018) <http://dx.doi.org/10.4324/9781315115788>.

economic, cultural and political institutions.'[199] They safeguard the rights of the voiceless[200] and maintain links to past and future generations. The International Environmental Law is directly linked to indigenous peoples' rights, and various civil society organisations advocate for their protection, trying to prevent states from forcing their 'development' ideologies on them.[201] Indigenous peoples also have strong connections to the sky and the cosmos. Light pollution has affected their ability to observe the various constellations and celestial objects, and this loss could even fall into the scope of cultural genocide.[202] According to the Native Skywatchers, an initiative that seeks to restore the indigenous knowledge on stars and the Earth, indigenous peoples have critical relationships with the sky and stargazing, which is currently at risk because of the Western practices in pursuit of profit. Moreover, indigenous peoples are against the use of the terms 'Anthropocene' and 'anthropogenic', as they generate the false impression that all people are equally responsible for climate change and environmental degradation.[203] Furthermore, they do not support the plans for space settlements, since they remind them of past colonial practices that resulted in the destruction of ecosystems they were depending on, and they will most likely worsen their connections to the sky. Instead, they are able to propose 'decolonising' solutions[204] to deal with climate change, with respect to the environment and in agreement with ecocentric ethics.

To further understand the unique ties of indigenous peoples with the Earth, outer space and celestial bodies, a few examples need to be mentioned. Firstly, Inuit in Alaska, according to an anthropologist's personal interaction with them, have argued that their shamans have been

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[199] ILO Convention C169, art 1 (b), p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C169, < https://www.ilo.org/dyn/normlex/en/f?>

[200] Abate (no 46) 15.

[201] Andrew Scholten and others, International Environmental Law: A Human Rights Oriented Approach. Congress on Public Health 3.

[202] Nicola Davis, 'End 'Colonial' Approach to Space Exploration, Scientists Urge' (2023) <www.theguardian.com/science/2023/mar/04/end-colonial-approach-to-space-exploration-scientists-urge>.

[203] Whyte (no 29) 155.

[204] Karsten Schulz, 'Decolonising the Anthropocene: The Mytho-Politics of Human Mastery' in Marc Woons and Sebastian Weier (eds), *Critical Epistomologies of Global Politics* 62 (E-International Relations Publishing 2017).

going to the Moon for a long time, treating the Moon and its indigenous life with respect,[205] while aboriginal people at Woomera and Pitjantjatjara Country in Australia try to keep their ties with the earth and sky intact despite the obstacles they confront in the face of development.[206] Puebloans consider all celestial bodies as living entities, 'not objects to be walked on or travelled to.'[207] Particularly, the Zuni Puebloans in New Mexico believe in the interconnectedness of the universe, as do the Cherokees.[208] Māori have adopted a concept of guardianship[209] and they follow a lifestyle based on the principles of sustainability. Lastly, Native Americans' viewpoint and customs are completely opposed to private enterprises' space colonisation plans.[210] The terms 'colonisation' and 'frontier', frequently used in the discourse related to space activities, have critical historical significance for them.[211] They consider themselves as relatives to the celestial bodies[212], and refer to the universe as 'Father Sky', considering it as a living being.[213] They also argue for the inclusion of ethics in the discussion regarding the protection of the night sky, as merely identifying the connections of living beings with the sky is not enough.[214] Indigenous Americans recognise the interconnectedness between humans and the environment. Fire and Erdoes highlight that, 'being a living part of the earth, we cannot harm any part of her without hurting ourselves.'[215] As Forbes aptly writes, 'If I lose the sun I die. If I lose the earth I

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[205] Jane Young, "'Pity the Indians of Outer Space': Native American Views of the Space Program" (1987) 46 Western Folklore 269, 272 <http://dx.doi.org/10.2307/1499889>.

[206] Marisa Peryer, 'Native Hawaiians on Coverage of Mauna Kea Resistance' (Columbia Journalism Review 2019) <www.cjr.org/opinion/mauna-kea-telescope-protest-hawaii.php>.

[207] Young (no 205) 277-278.

[208] ibid 275.

[209] Bas Verschuuren, 'World Heritage Sites and Indigenous Peoples' Rights' (2016) 14 Conservation and Society 161, 161 <http://dx.doi.org/10.4103/0972-4923.186337>.

[210] Young (no 205) 272.

[211] ibid 272.

[212] Young (no 205) 274; Winona LaDuke, *All Our Relations: Native Struggles for Land and Life* 2 (South End Press 1999).

[213] Young (no 205) 271.

[214] Jack Forbes, 'Indigenous Americans: Spirituality and Ecos' (2001) 130(4) Daedalus 28, 292< http://www.jstor.org/stable/20027728>.

[215] John Fire, Richard Erdoes, *Lame Deer, Seeker of Visions* 266 (Schuster New York 1972).

die. [...] If I lose the plants and animals I die. All of these things are more a part of me, more essential to my every breath, than is my so-called body. [...] We are rooted just like the trees. But our roots come out of our nose and mouth, like an umbilical cord, forever connected with the rest of the world.'[216]

To sum up, spacefaring nations and the rest of the humankind have a lot to learn from indigenous communities. For generations, many of them have managed to embrace a fully cosmocentric worldview, guiding them in their everyday activities. Even in indigenous science fiction or Afrofuturism,[217] one can find numerous ecocentric practices as examples to follow. Therefore, indigenous views can provide paths other than our narrow and materialistic approaches, and we should 'stand to gain pearls of wisdom'[218] from them.

5. International space law regime

5.1. Overview

5.1.1. Overview of the legal framework

International space law is the body of law that governs space-related activities. With origins dating back to 1919, it emerged as a subset of public international law. Space law comprises of various legal instruments, all of which stress the importance of international cooperation, while highlighting that the benefits of space exploration should be dedicated to improving the well-being of all humankind.

The most important treaty in the regime of international space law is the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space,

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[216] Jack Forbes, *A World Ruled by Cannibals: The Wetiko Disease of Aggression, Violence, and Imperialism* 85-86 (Davis, Calif.: D-Q University Press 1979).

[217] William Lempert, 'Decolonizing Encounters of the Third Kind: Alternative Futuring in Native Science Fiction Film' (2014) 30 Visual Anthropology Review 164, 165 <http://dx.doi.org/10.1111/var.12046>.

[218] Abate (no 46) 15.

including the Moon and Other Celestial Bodies[219], adopted on January 27, 1967, and entered into force on October 10, 1967. It has been ratified by 110 countries and establishes the essential outline for international space law, providing a basis for further elaboration. The OST stipulates the fundamental principles that guide all space activities. It is important to mention that private entities are not bound by the provisions of the OST and do not owe human right obligations directly; however, according to Article VI of the OST, States ’bear international responsibility for national activities in outer space‘, including those by ’non-governmental entities’, which States are obliged to authorise and supervise. Kerrest points out though that the principal vulnerability of the OST lies in its complete reliance on state-centric principles,[220] largely neglecting the regulation of corporate accountability.

Secondly, the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space[221] was adopted on December 19, 1967, and entered into force on December 3, 1968. It develops Articles 5 and 8 of the OST, highlighting that States are obliged to take all possible steps to rescue and assist astronauts in distress. Thirdly, the Convention on International Liability for Damage Caused by Space Objects,[222] adopted on November 29, 1971, and entered into force on September 1, 1972, elaborates on Article 7 of the Outer Space Treaty, highlighting that a State has absolute liability to pay compensation for fault-based damage caused by its space objects. Moreover, the Convention on Registration of Objects launched into Outer Space[223] was adopted on November 12, 1974, although it has been negotiated since 1962, and entered into force on September 15, 1976. Based on aspirations expressed by States, it regulates the responsibility of States related to their space objects, while it compels the Secretary General (SG) to guarantee full and open access to information for all States. Lastly, the Agreement Governing the Activities of States on the Moon and Other Celestial

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[219] 18 UST 2410 610 UNTS 205, 61 ILM 386 (1967) [hereinafter referred to as Outer Space Treaty (OST)].

[220] Armel Kerrest, 'Remarks on the Responsibility and Liability for Damages Caused by Private Activity in Outer Space' (1997) 40 Proclamations on the Law of Outer Space 139, 141.

[221] 18 UST 2410 610 UNTS 205, 61 ILM 386 (1967) [hereinafter referred to as the Rescue Agreement].

[222] 24 U.S.T. 2389, 861 U.N.T.S. 187, 10 i.L.M. 965 (1972) [hereinafter referred to as the Liability Convention].

[223] 28 UST 695, 1023 UNTS 15, 14 ILM 43 (1975) [hereinafter referred to as the Registration Convention].

Bodies[224] was adopted on December 5, 1979, but only entered into force on July 11, 1984. It elaborates on various provisions of the OST, emphasising that outer space shall be used solely for peaceful purposes and that States shall not destroy the extraterrestrial environment. It also stipulates that the Moon and other celestial bodies are the common heritage of mankind and calls for the establishment of an international regime to govern the exploitation of space resources. However, as of 2023, it has only been ratified by 18 States, including none of the spacefaring nations.

Apart from the above-mentioned binding treaties, the soft law pillar consists of non-binding principles that have mainly been adopted by the UN General Assembly (UNGA), such as the 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques. Some multilateral treaties are also noteworthy, namely the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Partial Nuclear Test Ban Treaty). Lastly, non-binding guidelines adopted by international organisations are becoming increasingly significant and address burning issues in space law, some examples being the COSPAR Policy on Planetary Protection, the COPUOS Space Debris Mitigation Guidelines, and the Inter-Agency Space Debris Coordination Committee (IADC) Guidelines.

Soft law principles are non-binding; however, some of them hold a customary status in international space law,[225] such as the international responsibility of States for damage caused, the principle of international cooperation, the duty to avoid harmful contamination of outer space and adverse changes on the Earth's environment, the prohibition of testing using nuclear energy in outer space, and the obligation of notification.

5.1.2. The legality of space colonisation

Having described the International Space Law regime, this section will investigate the legality of space colonisation based on the OST, as the latter provides the basic framework regulating space

[224] 1363 UNTS 22, 18 ILM 1434 (1979) [hereinafter referred to as the Moon Agreement (MA)].

[225] Nicolas Matte, 'Environmental Implications and Responsibilities in the Use of Outer Space' (1989) 14 Annals Air & Space L 419, 441-442.

activities. Scholars agree that space law is applicable to space colonisation, from the beginning of the journey until the end.[226] The alternative option would be the application of air law or a combination of the two, which would be complicated or even impossible due to the lack of sovereignty in outer space. The legality of space colonisation is contested, and views differ depending on the applicable legal test.

The OST is broadly recognised as the main source of regulation of space activities, so the applicable legal test will be derived from the OST for the purposes of this thesis. As with any other space activity, space colonisation also falls within its scope. Regarding its legality, at first sight it seems that such practice is simultaneously allowed and prohibited based on a literal interpretation of the text. Specifically, based on Article I OST, settlements can be permitted if they contribute to the well-being of humankind. However, Article II OST is opposed to colonial practices that would appropriate part of outer space. To offer a solution to this paradox, Kerkonian points to the Vienna Convention on the Law of the Treaties (VCLT);[227] if the interpretation of a treaty according to the letter of the law 'leads to a result that is manifestly absurd or unreasonable' (Article 31), 'recourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances surrounding its inclusion' (Article 32) to reach the correct interpretation. During the drafting process of the OST, the desired aim was to prevent States from appropriating celestial bodies, as they wanted to prevent the domination of space by a handful of nations. Thus, Kerkonian goes on to argue that, if spacefaring states manage to refrain from imperialistic practices, space colonisation can be justified[228]. Interestingly though, none of the space actors so far has declared that the space settlements proposed will serve all humanity and be in their best interests.[229] Space colonisation could also be justified under Article I para 2 OST, within the principle of freedom of exploration

[226] Steven Freeland, 'Up, Up and . . . Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space' (2005) Chicago Journal of International Law 6, 9.

[227] Kerkonian (no 76) 465-466.

[228] ibid 468.

[229] ibid.

and use of outer space.[230] Nevertheless, Article IX OST on environmental protection limits the scope of Article I, and, as section 3.4.2. demonstrated, human settlements in space will lead to an unprecedented large-scale environmental degradation. Especially if humans proceed with terraforming, it will be more challenging to comply with the provisions of the OST.[231] One could also argue that plans to settle the cosmos agree with the principle of free access to celestial bodies, enshrined in Article I para 2 OST, but a mass human inhabitation of outer space would exceed the threshold of bare access.[232] Lastly, colonies as we know them are not permitted in international law, so the terminology used so far is opposed to international legislation. Prima facie, it looks like one could easily conclude that space colonisation will likely not agree with the provisions of the OST and thus be prohibited.

Yet, the anthropocentric interpretation of the OST leads to a different conclusion. Previous parts of this thesis have already demonstrated that Western affluent nations toss aside the needs of the developing countries, who end up not being a part of the equation. That being said, space colonisation could de lege lata be justified, considering that (a) Western views on the benefits and necessity of space colonisation are presented as a universal opinion, concluding that space settlements will be in all humankind's best interest, (b) the environment per se is not protected in any of the space treaties and, according to our anthropocentric foundation, celestial bodies are devoid of life, thus with no inherent value and (c) space settlements do not fall into the definition of colonies, as the extraterrestrial environment is considered de lege lata 'unoccupied' and with no people to colonise.

The analysis that follows will be based on the lex lata. Space colonisation plans can be justified under the current anthropocentric provisions of the OST, as emphasis is placed on the human survival, the constant growth and the financial development of States rather than on the environment.

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[230] Kyriakopoulos (no 76) 169

[231] Levchenko and others, (no 79) 8.

[232] Kyriakopoulos (no 76) 177.

5.2. Current provisions on environmental protection and cosmocentric critique

After discussing the colossal environmental destruction space colonisation is likely to cause, and after describing the current international space law framework, this section will focus on the two most important treaties concerning the protection of the environment, namely the OST and the MA. It will critically examine their provisions related to the protection of the environment, bringing the existing legal gaps to the surface.

Article IX of the OST provides the basis of environmental protection regarding outer space and the foundation for further elaboration on the debate regarding the preservation of the outer space environment for its own sake.[233] Most importantly, it stipulates that States shall avoid 'harmful' contamination' and 'adverse changes' on the environment. The former refers to the environment of outer space, while the latter, whose scope is broader, refers to the Earth's environment. The definition of these phrases is not provided. Scholars argue that the interpretation of 'contamination' is restrictive,[234] but others highlight that it must be given a broad definition, including forward and back contamination,[235] pursuant to the teleological interpretation of Article IX of the OST. To this direction, recent interpretations point out that 'harmful contamination' should be construed as containing all space activities, scientific, commercial ones or others,[236] including space colonisation, as at the time when this treaty was negotiated and adopted, States could not have expected the variety of uses of outer space in the New Space era.[237] Moreover, Article IX states that such contamination or changes shall be

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[233] Claudia Cinelli and Katarzyna Pogorzelska, 'The Current International Legal Setting for the Protection of the Outer Space Environment: The Precautionary Principle Avant La Lettre" (2013) 22 Review of European, Comparative & International Environmental Law 186, 192 <http://dx.doi.org/10.1111/reel.12026>.

[234] Philippe Achilleas, 'Planetary Protection - Legal Issues' (2003) 46 Proc on L Outer Space 214, 215.

[235] Nicholas Poulantzas, 'Legal Problems arising out of environmental protection of Earth' (1971) Proceedings of the 14th Colloquium on the law of outer space 75; Stephen Gorove, 'Legal Aspects of Pollution and Outer Space' (1971), Proceedings of the 14th Colloquium on the law of outer space 67 (1971).

[236] Achilleas (no 234) 215; Howard A. Baker, 'Protection of the Outer Space Environment: History and Analysis of Article IX of the Outer Space Treaty' (1987) 12 Annals Air & Space L 143, 162.

[237] Steven Freeland, 'Fly Me to the Moon: How Will International Law Cope with Commercial Space Tourism?' (2010) 11(1) MelbJlIntLaw 90, 95.

'avoided', which means that 'avoidance may be the intent; it need not be the result.'[238] What actions should be avoided is not specified, and this provision only encourages States to try to refrain from harmful practices, even if they do not success at preventing harmful contamination or adverse changes on the environment. The definition of 'harmful interference' is also not provided, although it is widely accepted that only actions meddling with other States' space activities are included in the definition.[239] Although this provision was meant to include only harmful interference in outer space, Gorove argues that it could also refer to interference on Earth.[240] Regarding the 'introduction of extraterrestrial matter', it is not clear whether introduction without fault is also covered. Baker also claims that States who want to ensure the protection of the outer space environment could refer to sentence 4 of the same article, however both sentence 3 and sentence 4 adopt subjective criteria,[241] since it is left upon States to evaluate whether another State's activity will cause harmful interference. Lastly, the principle of prior consultation found in sentence 3 provides a useful tool for States parties. Indeed, the Artemis Accords adopted by NASA in 2020 acknowledge the importance of the principles of prior consultation and due regard.[242] Yet, it is not mandatory for States that the information be both comprehensive and given to the States parties promptly, so the latter have enough time to study it before the consultation takes place.[243] Needless to mention that States are not even obliged to proceed with the aforementioned consultation.

In general, the language used in Article IX (and in the rest of the OST provisions as well) is imprecise and full of vague terms; hence, it is often considered by States as a non-binding

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[238] Baker, Analysis IX OST (no 236) 168.

[239] Vishakha Gupta, 'Critique of the International Law on Protection of the Outer Space Environment' (2016) 14 Astropolitics 20, 27 <http://dx.doi.org/10.1080/14777622.2016.1148462>.

[240] Gorove (no 141) 62-63.

[241] Matte (no 225) 12.

[242] Anne-Sophie Martin, Steven Freeland, 'Back to the Moon and Beyond: Strengthening the Legal Framework for Protection of the Space Environment' (2021), 46 (3) Air and Space Law 415, 435 <https://doi.org/10.54648/aila2021023>.

[243] Baker, Analysis IX OST (no 236) 164-65.

provision,[244] as it does not specify the States' obligations. Although some scholars argue that scientists are the most suitable ones to define those notions,[245] one needs to keep in mind that science can also produce subjective conclusions and can often express solely Western and anthropocentric views, so interpreters should be aware of this when attempting to understand the meaning of such provisions. As noted above, international space legislation, including the OST,[246] is largely coloured by anthropocentric notions. Particularly, during the drafting process of the OST, the sci-lab perception prevailed, as insightfully explained by Baker.[247]. According to the sci-lab perception, the environment of celestial bodies is protected only as long as it serves as a 'laboratory for scientific activity'.[248] This reflects the anthropocentric view that the environment has a value only if it provides for human beings. Thus, the environment per se is not safeguarded based on Article IX of the OST. The drafters were clearly not concerned with the protection of the environment; their aim was to ensure unimpeded conduct and integrity of any future scientific investigations. As Baker puts it, the protection of the environment under Article IX is 'only a fortuitous by-product'.[249] Therefore, the OST seems powerless and ineffective in the attempt to safeguard the space environment as an end itself.

The MA seems to be more environment-oriented. Firstly, Article 7 MA expands on the Article IX of the OST and it is considered as a step forward in the right direction. It also prohibits 'adverse changes' in the environment of celestial bodies, while paragraph 3 is devoted to planetary protection. The latter involves an important ethical element, although the protected areas are only to be preserved for scientific purposes. Paragraph 1 could also include space debris in the provision on harmful contamination if the damage caused is severe enough to

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[244] Gabriella Catalano Sgrosso, *International Space Law* 132 (Benedetta Ferri trs, LoGisma, 2011); Viikari (no 136) 59-60.

[245] Daniel Miklody, 'Some Remarks on the Legal Status of Celestial Bodies and Protection of Environment' (1982), 25 Colloquium Law of Outer Space 13, 13 / Dembling, Kalsi (no 155) 140.

[246] Gupta (no 239) 28.

[247] Harold A. Baker, "The Sci-lab Perception: Its Impact on Protection of the Outer Space Environment" (1987), 30 Colloquium Law of Outer Space, 121 ff.

[248] Baker, Analysis IX OST (no 236) 166.

[249] ibid 167.

disrupt the Moon's or other celestial bodies' environment.[250] However, Article 7 read in conjunction with Article 1 of the MA brings one to the conclusion that only a part of outer space is protected in the MA. Article 7 also does not stipulate any sanction mechanism to deal with potential damage caused.[251] Paragraph 3 of the same article is consistent with the principle of intergenerational equity, on a purely anthropocentric basis though. This principle is also enshrined in Article 11 of the MA, while Article 4 explicitly mentions their importance in guiding all space activities. Article 11 highlights the significance of the equitable share of benefits of space exploration, while Article 4 promotes the principle of sustainability in paragraph 1, linked to the obligations we owe to future generations. The latter has also been considered as an expression of customary law.[252] Furthermore, the environmental orientation of the MA is also detectable in paragraph 5 of Article 5, which states that there is an 'obligation to inform the UN Secretary General, the public and the international scientific community of any indications of organic life and any phenomena discovered by States Parties in space and on the Moon that could endanger human life or health.'[253] The above-mentioned obligation follows anthropocentric and bioethical approaches to the environment, as it considers only potential violations of the human right to life or health, tossing aside the protection of the environment for its own sake. Lastly, Article 14 states that elaboration on the procedure dealing with State's liability for damage in outer space is required, however States did not proceed with such arrangements, based on the disputed status of the MA as a universally applicable and binding norm.[254]

On that note, it should be clarified that the main weakness of the MA is its lack of enforcement, as its legally binding character is widely questioned. It only applies to the States

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[250] Vladimir Kopel, 'Is the Present Interantional Space Law Sufficiently Armed for the Protection of Astronauts, Functional Space Objects and Space Environment against Space Debris, or Should a Legal Regulatory System Relating to this Issue be Established Soon?' (2003) 46 Proceedings on the Law of Outer Space 288, 292.

[251] Matte (no 225) 14-15.

[252] Vladlen Vereshchtein and Gennady Danilenko, 'Custom as a Source of International Law of Outer Space' (1985) 13/1 Journal of Space Law 33.

[253] Paulose (no 65) 316.

[254] Sandeepa Bhat, 'Application of Environmental Law Principles for the Protection of the Outer Space Environment: A Feasibility Study' (2014) 39 Annals Air & Space L 323, 338.

parties, and the major spacefaring nations have not ratified it which, according to Cooper,[255] is because it ensures fair and impartial execution of space activities with respect to the interests of the developing countries. Due to the limited number of missions to the Moon after the MA entered into force, the MA does not constitute legal custom.[256] Another line of thought on its customary status demonstrates that, since there are only a few spacefaring nations and the practice of space activities is not long,[257] 'instant international customary law' could be created [...] provided that the opinio juris of the states concerned can be clearly established' and that 'international customary law has in reality only one constitutive element, the opinio juris.'[258]

For the purposes of this thesis, the research will focus on the two above-mentioned treaties, as they provide the basis for further development of the legislation in the direction of the environmental protection. Nevertheless, it is worth mentioning that Article II of the Liability Convention can be useful, as it regulates the absolute State liability for damage caused by the State's space objects, although it is not clear if space debris fall into the definition of space objects as provided by Article I. The latter also clarifies the terms 'space damage', 'launch' and 'launching State'; regarding space damage, humanity as a whole[259] or the environment per se do not fall into its definition. In addition, Article 5 of the Rescue Agreement could be applied to space debris, while the more precise Articles II and III of the Registration Convention could be useful in identifying the State responsible for damage caused by space objects.

In summary, it is evident that States are not obliged de lege lata to prevent harm to the space environment for its own sake under any of the international treaties on space law. Space legislation is largely Earth-oriented,[260], but still coloured with anthropocentric views which

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[255] Lawrence Cooper, 'Encouraging Space Exploration through a New Application of Space Property Rights' (2003) 19 Space Policy 111, 112 <http://dx.doi.org/10.1016/s0265-9646(03)00016-x>.

[256] Cocca and others (no 8) 341.

[257] Nie Jingjing and Yang Hui, 'Revisit the Concept of International Custom in International Space Law' (2012) 55 Proc Int'l Inst Space L 348, 351.

[258] Bin Cheng, *Studies in International Space Law* 138 (2nd eds, Clarendon Press 1997).

[259] Piotr Manikowski, 'Examples of Space Damages in the Light of International Space Law' (2006) 6(1) EBR 54, 60.

[260] Marchisio (no 128) 11.

dominated all the drafting procedures. Even the OST, which is considered the mother of all space law treaties, appears 'toothless',[261] as it is not adequate to deal with rising burning issues like space colonisation. Moreover, the launch phase is very poorly regulated,[262] while the existing legislation has been characterised as a 'hodge-podge of ill-defined provisions and principles'.[263]

Undeniably, legal scholars recognise the inadequacy of space law to address issues such as space colonisation, which will add to the already pressing concerns of climate change, and stress the immediate need for alternatives. This legal vacuum in the space regulation[264] is unsurprising; international space law is a young area of legislation, which makes it underdeveloped when dealing with environmental matters in comparison with international environmental law.[265] Legal scholars increasingly attribute these legal gaps to anthropocentrism, so it follows that an ecocentric perspective would be the way forward. An ecocentric interpretation would provide a remedy for these inadequacies, and numerous risks inherent to space activities such as space settlements would be averted.

5.3. Concept of 'common heritage of mankind' and global commons

To further understand the status of outer space, this section explores the concept of the 'common heritage of mankind', as mentioned in Article 11 paragraph 1 of the MA, which can largely contribute to the protection of the environment. It first appeared in Clarke's science fiction novel *Prelude to space,*[266] and it is an ethical concept of international law which establishes that some areas belong to all humanity and that everyone is free to use their resources. These areas shall be held in trust for future generations, taking into account the needs of developing countries. There

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[261] George Robinson, 'Humankind Space Migration: While Nero Fiddles, Will Space Lawyers Muse' (2013) 38 Annals Air & Space L 563, 571.

[262] Steven Freeland, Donna Lawler, 'Whose Mess Is It Anyway: Regulating the Environmental Consequences of Commercial Launch Activities' (2011) 54 Proc Int'l Inst Space L 318, 320.

[263] Hargrove (no 166) 183-210.

[264] Angie Buckley and others, 'Space Tourism: Risks and Solutions' in Galliott (ed) (no 91) 109.

[265] Paulose (no 166) 295.

[266] Arthur Clarke, *Prelude to Space* 102 (Ballantine Books 1951).

is still a huge debate on whether this concept is an international law norm or a policy objective.[267]

The concept of ‘common heritage of mankind’ is distinguished from the ‘province of mankind’, found in Article 4 of the MA and Article 1 of the OST.[268] The main difference between them is that, according to the ‘province of all mankind’, commercial uses of outer space are not explicitly prohibited, so they can be justified under the OST. The term ’mankind’ refers to a collective entity of people, therefore the rights of the collective differ from human rights,[269] which are granted to individuals solely because of being human. As outer space is considered a common heritage of mankind, it is part of the ’global commons’,[270] a concept closely linked to the former. The res communes omnium is a category of common spaces which are free for everyone to use and whose benefits should be shared with everyone, including developing countries. No state sovereignty applies to the global commons and, even if it is not explicitly mentioned in a relevant treaty, there is a duty to safeguard the environment, as enshrined in International Environmental Law.[271] This is crucial, especially if we consider the views of some proponents of commercial space activities; for instance, Jim Benson, an American aerospace entrepreneur and founder of SpaceDev, commenting on the benefits of private corporations’ benefits, declared that ’we took the risk, we paid the money, we flew our spacecraft, and we analyzed the content and the value of that asteroid. We landed on it. It's ours.’[272]

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[267] Mohammed Bedjaoui, *Towards a New International Economic Order* 233-40 (UNESCO 1979); Bradley Larshan and Bonnie Brennan, ’The Common Heritage of Mankind (1983) CJTL 305; Francesco Francioni, ’Antarctica and the common heritage of mankind' in Francesco Francioni and Tullio Scovazzi (eds), International Law for Antarctica 107-17 (Cambridge University Press 1987).

[268] cf. Nicolas Mateesco Matte, *Aerospace Law: Telecommunications Satellites* 77 (McGill 1982), who considers the two notions as synonyms.

[269] Stephen Gorove, ’The Concept of "Common Heritage of Mankind": A Political, Moral or Legal Innovation?‘ (1972) 9 SAN DIEGO L. REV. 390, 393.

[270] Francis Lyall, 'Protection of the Space Environment and Law' (1999) 42 Proc on L Outer Space 472, 478; See also Vladimir Kopal, 'Outer Space as Global Common: Concepts of Space Law and the Outer Space Treaty’ (1997) 40 Proc. IISL 106, 108-16.

[271] Kopal (n 271).

[272] Reed Elizabeth Loder, 'Asteroid Mining: Ecological Jurisprudence beyond Earth' (2018) 36 Va Envtl LJ 275, 308.

There is no absolute interpretation of the term 'global commons'; Boyle presents three possible interpretations, which link global commons with the notions of common property, common heritage, and common interest or common concern.[273] The former two are widely used with regard to outer space, but both possess a heavily anthropocentric colouring; thus, the use of the meaning of common interest or common concern is advisable, as it is more compliant to the proposed ecocentric view and the paradigm of cosmocentric ethics. Emerging from recent international environmental law, the concept of common concern is used by the Rio Declaration, the UNFCCC, and the Convention on Biological Diversity.[274] The notion of common concern applies to outer space as well, as it is of transnational nature.[275]

On that note, various scholars point out the similarities between outer space and the Antarctic environment,[276] in search of alternative solutions. The 1959 Antarctic Treaty (signed on December 1, 1959, entered into force on June 23, 1961) could offer some guidance for the protection of the outer space environment. In particular, the Protocol to the Antarctic Treaty on Environmental Protection,[277] adopted on October 4, 1991, and entered into force on January 14, 1998, declares the Antarctic a natural reserve and regulates its protection as a wilderness area, where State sovereignty does not apply. The Antarctic Treaty System could act as a first step in the protection of the extraterrestrial environment. To an extent, it is still infused with anthropocentrism, but it could guide space legislation in the right direction. A risk which persists is that this freedom to use outer space, given to all, could lead to massive environmental destruction, as Almár warns.[278] If humans fail to address such issues in time, this could lead to

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[273] Alan Boyle, 'Remedying Harm to International Common Spaces and Resources: Compensation and Other Approaches' in Peter Wetterstein (ed), *Harm to the Environment : the Right to Compensation and Assessment of Damages* 84 (Oxford University Press 1997).

[274] 1760 UNTS 79, 31 ILM 818 (1992).

[275] Boyle (no 273) 85.

[276] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* (Studies in Space Law 4, Brill 2009); Sterns, Tennen (no 142) 68-69; Lyall (no 270) 476.

[277] 30 ILM 1455 (1991) (Madrid Protocol).

[278] I Almár, 'What could COSPAR do to protect the planetary and space environment?' (2002) 30 (6) Advances in Space Research 1577, 1579 < doi: 10.1016/S0273-1177(02)00477-5>.

the 'tragedy of the commons',[279] signaling irreversible damage of the environment and abuse of celestial resources, which is anticipated every time humans do not face any obstacles.[280] Astrobiologist Haqq-Misra argues that we will face this tragedy sooner or later as humans expand their colonial tendencies among the stars.[281] As Seddon highlights, if such colonies are established on celestial bodies, the latter will soon become heritage of the colonists rather than of those left behind on Earth, at least when a mass settlement is established.[282]

To conclude, the concept of res communis can provide useful direction to legal scholars in the quest for regulating the safeguard of the outer space environment, in the context of the present space settlement aspirations. The relevance of the principle of 'common heritage of mankind' is debatable in the legal world, as the binding character of the MA is uncertain and there is no state practice suggesting opinio juris to declare it customary law. In any case, both concepts can offer a valuable starting point, although they cannot adequately contribute on their own to the protection of the celestial environment, which is constantly sacrificed on the altar of freedom of exploration and human greed.

6. Filling the legal gaps with environmental law principles

6.1. Fundamental environmental principles

6.1.1. Source and legal nature

The previous chapters demonstrated the ethical dilemmas, the human rights violations and the environmental consequences space colonisation will cause, framed as an environmental issue. Building on from the ideas of indigenous peoples on the environment and the sky, and considering that the environment and the enjoyment of human rights are interconnected, a

[279] Garrett Hardin, 'The Tragedy of the Commons' (1968) 162 Science 1243.

[280] Szocik, Reiss (no 60) 4; See also Martin, Freeland (242) 445.

[281] Haqq-Misra (no 83) 2.

[282] Robert Seddon, 'Exploring the Heavens and the Heritage of Mankind' in Galliott (ed) (no 91) 153.

cosmocentric ethic will be proposed to approach space colonisation activities. In addition to a cosmocentric ethic, a comprehensive legal framework must be in place to effectively address the potential environmental challenges brought by activities related to space settlements.

Having established in the previous chapter that the international space law regime contains plenty of unclear primary norms and legal loopholes regarding the protection of the global environment, other sources of international law must be considered. This section will propose an integration of environmental principles derived from soft law documents into international space law. Blagojević argues for an interpretation of the core treaties in light of the corresponding soft law provisions, which would eventually become customary regulations.[283] She explains that, since space legislation has not kept pace with science, transboundary environmental harm has caused a contemporary environmental crisis that links outer space and the Earth, emphasising the need for a shift to soft law and an interdisciplinary view of the corresponding principles.[284]

This thesis will focus on the precautionary principle, sustainability, and CBDR principles, as the most relevant to the governance of space colonisation as an ecological issue, and the closest towards achieving a cosmocentric-based legislation. They can be found in two non-binding, yet influential, legal documents, namely the Stockholm Declaration and the Rio Declaration. The former prioritised environmental concerns and contained 26 principles. It sparked a global discussion on the effects of environmental degradation on future generations[285] and represented the first time that developed and developing nations began to exchange views on economic progress, pollution, and global well-being. The Rio Declaration was adopted 20 years later, including 27 principles and addressing a variety of environmental issues, highlighting the importance of sustainable development.

Regarding their legal nature, both declarations are soft law documents, meaning that they contain non-binding principles of, mainly, moral significance. Conventions and other legal

[283] Paulose (no 65) 328.

[284] ibid 340.

[285] Düwell (no 198), 6.

documents may be interpreted in accordance with such legal principles of soft law.[286] Thus, they could be an important tool in the interpretation of the environmental provisions found in international space law treaties. Undeniably, soft law can gradually evolve into customary law,[287] but there is a debate on whether the environmental principles contained in the Stockholm and Rio Declarations currently constitute international custom. The latter is one of the main sources of international law and binds all States, regardless of their expressed consent[288] or its codification in an international convention or not. The elements required to establish a legally binding custom are state practice and opinio juris, a subjective component which demonstrates that such practice is ’carried out in such a way, as to be evidence of a belief that this practice is rendered obligatory by the existence of a rule of law requiring it’;[289] only then a legally binding international custom is created.

Each of the fundamental environmental principles holds a different status within the international law regime. The Stockholm Declaration and the Rio Declaration, as soft law documents, do not encompass binding obligations for States. However, the potential customary nature of each one of the aforementioned environmental principles should be investigated.

6.1.2. Why they apply to Outer Space and the viability of this solution over other proposals

Having discussed the legal nature of the principles contained in the Rio and Stockholm Declarations, this section will now examine whether the application of these environmental principles to international space law is possible in the first place.

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[286] Yoshiro Matsui, 'Some Aspects of the Principle of "Common but Differentiated Responsibilities"' (2002) 2 Int'l Env't Agreements: Pol L & Econs 151, 166.

[287] Ricky Lee and Steven Freeland, ’The Crystallisation of General Assembly Space Declarations into Customary International Law' (2003) Proceedings of the 46th Colloquium on the Law of Outer Space 122-23 <10.2514/6.IAC-03-IISL.2.05>.

[288] Michael Akehurst, ’Custom as a Source of International Law‘ (1976) 47 British Yearbook of International Law 1, 23 <http://dx.doi.org/10.1093/bybil/47.1.1>.

[289] North Sea Continental Shelf (Federal Republic of Germany/Netherlands), Judgment, ICJ Reports (1969) 3 para 77.

Notable academics stand in favour of the feasibility of such an application.[290] Viikari claims that they could form a foundation for further development of legal rules, and they are of utmost importance for addressing gaps in space treaties and resolving issues related to interpretation, while also accounting for the distinct characteristics of space operations[291]. Tan highlights that, while the two declarations have primarily emphasised the preservation of the Earth's environment, part of their principles should be applicable to the extraterrestrial environment as well.[292] The application of environmental principles to international space law is justified by Article III OST, which stipulates that space activities should be conducted ’in accordance with international law, including the Charter of the United Nations’. This provision explicitly states that international law can be applied to space law. The incorporation of space law within the framework of environmental law can also be inferred from the fundamental principles of legal doctrine. Space law is a lex specialis regarding international law; however, the general principles of international environmental law can be applied, with necessary adjustments, to address gaps in the specific provisions of international space law.[293] Besides, outer space is also considered as an environment, as was established in section 3.4.1. of the present thesis. As Lyall and Larsen aptly point out, ’environmental space law is simply a specialised area of environmental law’,[294] so similar concepts could apply, especially principles that are considered as customary law.[295]

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[290] Jean-Francois Mayence, 'Article IX of the Outer Space Treaty and the Concept of Planetary Protection: Toward a Space Environment Law' (2010) 53 Proc Int'l Inst Space L 697; Bhat (no 254) 323; Rutwik Navalgund, *Reduce, Reuse and Recycle: An Environmental Law Approach to Long-term Sustainability of Outer Space* (Universiteit Leiden, Faculty of Law 2019); Sara Dalledonne, ’International Environmental Law and Environmentally Harmful Space Activities: Learning from the Past for a More Sustainable Future‘ (2021) 13 Journal of Property, Planning and Environmental Law 139, 140 <http://dx.doi.org/10.1108/jppel-09-2020-0040>.

[291] Viikari (no 136) 128, 204.

[292] Tan (no 152) 178.

[293] Stephan Hobe and Steven Freeland, *In Heaven as on Earth? The Interaction of Public International Law on the Legal Regulation of Outer Space* 143 (Institute of Air and Space Law of the University of Cologne/Deutsches Zentrum für Luft- und Raumfahrt e.V. German Aerospace Center 2013).

[294] Lyall, Larsen (no 163).

[295] Ram Jakhu and Steven Freeland, 'The Relationship between the Outer Space Treaty and Customary International Law' (2016) 59 Proc Int'l Inst Space L 183, 183.

Various alternatives have been proposed by scholars to effectively protect the outer space environment. Most notably, some scholars argue for the drafting of a new international treaty focusing on environmental protection beyond earthly boundaries.[296] However, the creation of a treaty would be time-consuming and, as emphasised in the Introduction, the need for regulation regarding the environmental implications of space colonisation is urgent. Moreover, as mentioned in Chapter 5, the most recent of the space treaties, the MA, has only been ratified by very few States, including none of the spacefaring nations. Lyall underlines the huge existing workload within the realm of international law-making,[297] while he accentuates that the inclusion of extraterrestrial environmental issues on government agendas may require persuasive efforts.[298] In the same direction, other legal scholars propose a protocol or an amendment of the OST.[299] Such a solution would also be time-consuming, and it would be extremely difficult to address all environmental implications arising from space activities such as the establishment of permanent settlements. Lastly, a large part of the academia advocates the creation of specific protected areas, usually called planetary parks or wilderness areas.[300] However, Byerly is wondering which criteria will be used to elect the protected areas.[301] Moreover, the establishment of planetary parks presupposes that environmental damage can be isolated in a demarcated area, which is impossible given the interrelation of all parts of the global environment and the fragility of the outer space environment. This way, environmental pollution and disturbances in one area would

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[296] Howard A. Baker, 'Sci-Lab Perception: The Impact of Protection of the Outer Space Environment' (1987) 30 Proc on L Outer Space 121, 128; Ospina (no 127) 231; Irina Chernykh, 'International Legal Aspects on Sustainable Development of Outer Space Activities: Combine Safety and Effectiveness in the Long-Term' (2018) 61 Proc Int'l Inst Space L 581, 596.

[297] Francis Lyall, 'Protection of the Space Environment and Law' (1999) 42 Proc on L Outer Space 472, 472.

[298] ibid 480.

[299] Mark Williamson, 'Protection of the Space Environment under the Outer Space Treaty' (1997) 40 Proc on L Outer Space 296, 301.

[300] Hargrove (no 166) 187; William Hartmann, ’Space Exploration and Environmental Issues’ in Hargrove (eds) (n 264) 119ff; Charles Cockell, Gerda Horneck, ’Planetary Parks—Formulating a Wilderness Policy for Planetary Bodies‘ (2006) 22 Space Policy 256, 256-261 <http://dx.doi.org/10.1016/j.spacepol.2006.08.006> ; John Rummel and Pascale Ehrenfreund, 'Extending the Outer Space Treaty to Protect Planetary Environments' (2011) 54 Proc Int'l Inst Space L 510, 510; Martin Elvis, Tony Milligan, ’How much of the Solar System should we leave as Wilderness?‘ (2018), Acta Astronautica, <https://doi.org/10.48550/arXiv.1905.13681>.

[301] Hargrove (no 166) 96.

be justified solely by the existence of protected areas elsewhere. An ’unsettling’ formation of borders[302] on celestial bodies will not effectively prevent the degradation of the extraterrestrial ecosystems.

In this context, extending the interpretation of the main space treaties[303] through the application of environmental soft law seems viable. Scholars argue that environmental principles might need to be modified to be applicable to the safeguarding of the space environment.[304] Nevertheless, their growing significance is indisputable, and they can constitute a useful instrument to address the legal gaps found in the international space legislation.

6.2. The precautionary principle de lege lata

An environmental principle that will be a very useful tool in this undertaking is the principle of precaution, the cornerstone of international environmental law. The precautionary principle highlights the importance of taking preventive measures in the face of uncertain risks and is indissolubly linked with the notion of environmental harm.[305]

The Stockholm Declaration introduced the precautionary principle to the realm of international law,[306] and it was later reinforced by principle 15 of the Rio Declaration, which states that ’In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-

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[302] Marino (no 29) 31.

[303] Several academics stress the importance of soft law towards this aim, see eg Eloise Scotford, *Environmental Principles and the Evolution of Environmental Law* 2 (Hart Publishing 2017); Setsuko Aoki, ’The Function of ‘Soft Law’ in the Development of International Space Law‘ (2012) Soft Law in Outer Space 57, 72-3 <http://dx.doi.org/10.7767/boehlau.9783205791850.57>; Gupta (no 239); Martin, Freeland (no 242) 437; Sandeepa Bhat (no 254).

[304] Lyall (no 270) 341.

[305] For the concept of environmental harm see Arie Trouwborst, *Precautionary Rights and Duties of States* 37ff (Martinus Nijhoff Publishers 2006).

[306] Stockholm Declaration principles no 7 and no 21.

effective measures to prevent environmental degradation.'[307] It is widely accepted as a principle to guide States in preventing environmental harm and can be found in various international instruments. However, Viikari highlights that its usefulness diminishes significantly when evaluating the level of risk that can be deemed acceptable or when implementing measures to mitigate hazards.[308] There is no consensus on whether the precautionary principle has obtained a customary status in international law; some argue for its customary position,[309] others deny it,[310] and some support the view that it is in the process of obtaining it.[311] As of now, the customary status of the precautionary principle in international law remains a subject of ongoing debate and ad hoc interpretation.

It is imperative to differentiate between the precautionary principle and the principle of prevention. The latter still holds an important status internationally but is only relevant in situations where the risks are already known and more likely.[312] In comparison to this, the threshold for taking precautionary measures is lower, as the application of the precautionary principle is warranted in situations where there is uncertainty regarding the occurrence of damage or the underlying causes of existing damage.[313] This concept is applicable in situations where risks cannot be precisely measured, commonly referred to as potential risks. This objective

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[307] Rio Declaration principle 15.

[308] Viikari (no 136) 172; For instance, the UNFCCC, although it recognises the importance of the principle in art 3 para 3, it does not provide any further guidance on what measures need to be taken by the State, nor does it stipulate specific State obligations.

[309] See eg Olavo de O. Bittencourt Neto, 'Preserving the Outer Space Environment: The Precautionary Principle Approach to Space Debris' (2013) 56 Proc Int'l Inst Space L 341, 349.

[310] See eg Mariah Leach and Lakshman Guruswamy, *International Environmental Law in a Nutshell* 7553 (4th eds, West Academic Publishing 2014); Rob Amos, 'Exploiting the Final Frontier - Some Initial Thoughts on Regulating Humanity's Relationships with Non-Terrestrial Life Forms' (2021) 45 J Space L 111.

[311] International Tribunal for the Law of the Sea (ITLOS), 'Advisory Opinion on Responsibilities and Obligations of States with Respect to Activities in the Area' (2011) 17 Rep 10, para 135.

[312] For a more comprehensive understanding of the principle of prevention see UNEP Training Manual on International Environmental Law (2006) <https://wedocs.unep.org/20.500.11822/20599>.

[313] Wybe Douma, 'The Precautionary Principle in the European Union' (2000) 9 Review of European Community & International Environmental Law 132, 132 <http://dx.doi.org/10.1111/1467-9388.00244>; Aline Jaeckel, 'The International Seabed Authority and the Precautionary Principle' (Publications on Ocean Development 35, Brill | Nijhoff 2017); See also Patricia Birnie and others, *International Law and the Environment* (Oxford University Press 2009), 148ff.

foreseeability of harm[314] refers to the ability to reasonably anticipate or predict potential harm or negative consequences in each situation. Thus, the application of the precautionary principle can be proven useful when confronted with environmental hazards, as a lot is at risk, and potential harm might be permanent. Regarding the burden of proof, the precautionary principle often reverses it,[315] as the ability of a State to engage in a potentially risky endeavour is contingent upon the capacity to demonstrate that the above-mentioned action will not endanger the environment. As de Sadeleer accurately pointed out, 'previously the polluter benefited from scientific doubt; henceforth doubt will work to the benefit of the environment.'[316]

Translating the precautionary principle into space law would entail a meticulous evaluation of prospective environmental hazards and the implementation of preventive measures to mitigate harm, even in the absence of definitive scientific evidence. Although the precautionary principle has received criticism,[317] mainly characterised as vague and ambiguous, legal scholars emphasise its flexibility[318] and argue for the relevance and feasibility of its application to outer space activities.[319] Martin and Freeland find its application specifically suitable regarding future plans of space colonisation.[320] As was demonstrated in section 5.3.,

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[314] Viikari (no 136) 161.

[315] Viikari (no 136) 169; Elli Louka, *International Environmental Law: Fairness, Effectiveness, and World Order* 50 (Cambridge University Press 2006).

[316] Nicolas de Sadeleer, *Environmental Principles: From Political Slogans to Legal Rules* 223 (2nd ed, Oxford University Press 2020).

[317] Daniel Bodansky, 'Scientific Uncertainty and the Precautionary Principle' (1991) 33 Environment, 4–5, 34–44; Per Sandin and others, 'Five Charges against the Precautionary Principle' (2002) 5 Journal of Risk Research 287, 287ff <http://dx.doi.org/10.1080/13669870110073729>.

[318] Jaeckel (no 313) 32.

[319] Paul Larsen, 'Application of the Precautionary Principle to the Moon' (2006), 71(2) J. Air L. & Com. 295–306; Viikari (no 136) 160; Olavo de O. Bittencourt Neto, Preserving the Outer Space Environment: the 'Precautionary Principle' Approach to Space Debris, 56 Proc. Colloquium on the L. Outer Space 341–351 (2013); Claudia Cinelli, Katarzyna Pogorzelska, The Current International Legal Setting for the Protection of the Outer Space Environment: The Precautionary Principle Avant La Lettre, 22(2) Rev. Eur. Community & Int'l Envtl. L. 186–201 (2013), 201; Tan (no 152) 179.

[320] Martin, Freeland (no 242) 426.

outer space belongs to the category of the global commons; subsequently, the precautionary principle will also apply to the extraterrestrial environment as res communis.[321]

In light of the precautionary principle, the interpretation of Article IX OST should involve a proactive approach to prevent any potential harm or contamination of celestial bodies. This approach advocates for spacefaring nations to interpret and implement the obligations of the treaty and adopt precautionary measures in order to prevent contamination or irreversible harm. Such measures could include following rigorous cleanliness protocols and sterilisation procedures before implementing any activity in outer space. The integration of the precautionary principle within the framework of space law will enable the formulation of guidelines and regulations aimed at evaluating and effectively addressing the prospective ecological hazards linked to endeavours related to space colonisation. Furthermore, this approach should acknowledge the necessity of conducting thorough evaluations regarding the potential ecological ramifications of space endeavours, even in situations where the available scientific data may be inconclusive. Given the uncertainty surrounding the long-term effects of space colonisation, an early assessment of a project's environmental implications through the implementation of an Environmental Impact Assessment (EIA) is of significant importance[322] and aligns with the application of the precautionary principle. EIAs should also be conducted before the realisation of space settlements plans made by private legal entities, as States should continuously supervise them. This initiative aims to foster responsible decision-making and encourage the adoption of sustainable practices in the exploration and utilisation of extraterrestrial environments. However, the majority of EIAs carried out thus far have failed to account for potential consequences extending beyond the confines of Earth's atmosphere.[323] By integrating the aforementioned elements, the analysis of Article IX of the OST can establish a more robust basis for protecting extraterrestrial ecosystems and promoting conscientious exploration.

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[321] Robert Percival, 'Who's Afraid of the Precautionary Principle?' (2006) 23 Pace Environmental Law Review 21 <http://dx.doi.org/10.58948/0738-6206.1073>; Marchisio (no 128) 12; Viikari (no 136) 169; Larsen (n 320) 117. The latter highlights the significance of the principle of precaution in light of human activities on the Moon, such as colonisation, and argues that 'If the Precautionary Principle can be applied to Antarctica, then the Precautionary Principle can also apply to the Moon.' (117).

[322] Martin, Freeland (no 242) 426.

[323] ibid.

Moreover, according to Article 7 of the MA, it is required that states take appropriate measures to prevent any disturbance to the current equilibrium of the lunar environment of the Moon during their activities.[324] Subsequently, States parties should inform the SG of the UN of the measures taken.[325] Additionally, it necessitates that States parties provide notification to the global community regarding their endeavors and engage in collaborative efforts to prevent detrimental interference with the undertakings of other states.[326] When considering Article 7 of the MA within the framework of the precautionary principle, it can be argued that states and entities involved in activities related to space exploration and exploitation should adopt precautionary measures aimed at mitigating potential adverse effects on the lunar environment. The interpretation may also suggest that in cases where there is scientific uncertainty surrounding the potential environmental consequences of a particular activity, it is advisable for States and private entities to exercise caution and implement measures aimed at preventing any potential harm. From a practical standpoint, it is imperative to establish a framework of transparency and international collaboration to effectively address potential risks. However, it is noteworthy to consider that the MA has not garnered extensive ratification and is not regarded as a legally binding framework by prominent spacefaring nations.

As has been previously established, space activities such as space colonisation are inherently hazardous per se. The task of restoring the space environment following potential damage is challenging – if not impossible – given our current limited comprehension of space and its mechanisms.[327] Besides, no nation, or amalgamation of nations, possesses the financial resources or technological capabilities to effectively address the consequences or bear the financial burden resulting from the aforementioned circumstances.[328] Therefore, to effectively avert an irreversible environmental destruction, precautionary measures are needed. The latter

[324] Art 7 para 1 MA.

[325] ibid, para 2.

[326] ibid, para. 3.

[327] Viikari (no 136) 173; Martin, Freeland (no 242) 428.

[328] Esquivel de Cocca, 'International Liability for Damages Caused by Persons or Space Objects in Outer Space or on Celestial Bodies to Persons, Properties or Environment in Outer Space or Celestial Bodies' (2000), Proceedings of the 42nd Colloquium on the Law of Outer Space 55.

serve to safeguard the interests of both humans who may be affected by environmental damage and the environment itself;[329] hence, precautionary measures are more ecocentric in nature.[330]

6.3. Principle of common but differentiated responsibility de lege lata

Another principle of equal importance is the principle of CBDR, which acknowledges the varying capacities and historical involvement of states in environmental matters. It is closely linked to the concept of climate justice, as explained in section 2.4. of this thesis, intragenerational equity[331] and sustainable development.

The principle of CBDR is expressed in the Preamble and principle 12 of the Stockholm Declaration, as well as principle 7 of the Rio Declaration, in accordance with principle 6 on the special situation and needs of developing countries. Viikari notes that contemporary environmental deterioration primarily stems from industrialised nations, thereby necessitating their primary responsibility in addressing the adverse consequences of pollution,[332] as these countries are the ones which contributed the most to the environmental degradation. CBDR's customary status in international law is under dispute,[333] but scholars highlight its legal

[329] Viikari (no 136) 159.

[330] Paulose (no 65) 312.

[331] Philippe Sands, *Principles of International Environmental Law* 285 (Cambridge University Press 2018) <http://dx.doi.org/10.1017/cbo9780511813511>.

[332] UNCOPUOS Report of the Scientific and Technical Subcommittee on its 42nd Session (2005) A_AC. 105_848-AR, para 99.

[333] Philippe Cullet, 'Differential Treatment in International Law: Towards a New Paradigm of Inter-State Relations' (1999) 10 European Journal of International Law 549, 579 <http://dx.doi.org/10.1093/ejil/10.3.549>; M Abdolahi, S Moarefi, 'Common but Differentiated Responsibility Principle in International Environmental Law (2010) Public Law Research, 12(29), 199.

significance in the realm of international law.[334] According to numerous academics, it constitutes a legal principle or a fundamental principle of international environmental law.[335]

In the context of space colonisation, the principle calls for shared responsibility among spacefaring nations, considering the differing capabilities of States in addressing the environmental implications of space colonisation. It has emerged from the notion of 'common heritage of mankind'[336], demonstrated in section 5.3, and underlines the importance of collaboration, cooperation, and fair allocation of resources and advantages. Viikari points out that while industrialised nations feel an urgent need to expand their space activities, which could increase space pollution, developing nations often insist on safeguarding the space environment to ensure their future opportunities for space travel.[337] Advanced spacefaring nations bear a responsibility to aid developing nations in their pursuit of space activities, ensuring their participation is environmentally sustainable. This may involve knowledge sharing, technology transfer and financial support.

Towards this direction, Article 7 of the MA should be interpreted so as to consider the uneven power relations and the possibility for exploitation that are inherent to space colonisation, in accordance with this differentiated approach. This form of positive discrimination is justified by the varying social, economic and ecological situation of States.[338] Moreover, incorporating the principle of CBDR into current space law would entail increased responsibility of launching

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[334] Lavanya Rajamani, 'The Principle of Common but Differentiated Responsibility and the Balance of Commitments under the Climate Regime' (2000) 9 Review of European Community & International Environmental Law 120, 124 <http://dx.doi.org/10.1111/1467-9388.00243>; Yoshiro Matsui, 'Some Aspects of the Principle of "Common but Differentiated Responsibilities"' (2002) 2 Int'l Env't Agreements: Pol L & Econs 151, p. 167; Xiaodan Wu, 'China and Space Environment Protection: An Evaluation from an International Legal Perspective' (2013) 56 Proc Int'l Inst Space L 425, 428; Seyed Mohammad Hosseini and others, 'Space Debris Mitigation: Some Lessons from International Environmental Law' (2021) 51 Environmental Policy and Law 391, 397 <http://dx.doi.org/10.3233/epl-210015>.

[335] See Matsui (no 334) 166 and the corresponding footnotes.

[336] Abdolahi, Moarefi (no 334) 199.

[337] Viikari (no 136) 182.

[338] U Mukherjee, A Mokkapati 'Determining liability for damage caused due to debris in outer space: Portal to a new regime' 2009 Proceedings of the International Institute of Space Law 52, Colloquium on the Law of Outer Space 294.

States, for instance regarding space debris released due to the launching States' activities.[339] The application of CBDR could also ensure that all entities have a say in decision-making. By adopting this view, space operations would become more just and inclusive, striking a better balance between the needs of different nations and acknowledging the collective duty to safeguard the Moon's ecosystem. Thus, it could effectively safeguard even the rights of the voiceless. Nevertheless, Abate argues that the recognition of the rights of future generations, wildlife and nature emerged as a response to the insufficient progress made in addressing the climate change crisis through the CBDR within the UNFCCC regime.[340]

Translating the principle of common but differentiated responsibility into space law promotes the collective management of environmental consequences associated with space colonisation. This approach guarantees a more inclusive character of space activities and fosters fairness and sustainability in the space sector.

6.4. Sustainability principle de lege lata

The last principle that will be examined is the key principle of sustainability. The latter, which is based on the concept of sustainable development, calls for development that 'meets the needs of the present generation without compromising the ability of future generations to meet their own needs.'[341] Later, the UN Environment Program (UNEP) expanded on the concept of sustainability by emphasising the importance of intragenerational and economic equity.[342] Sustainability is indeed closely linked to the rights and obligations towards all present and future generations.

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[339] Hosseini, Fathpour (no 334) 396-397.

[340] Abate (no 46) 10.

[341] World Commission on Environment and Development (WCED), 'From One Earth to One World' (1987) 'Our Common future' para 27 (Brudtland Report).

[342] Viikari (no 136) 132.

The sustainability principle is permeated throughout the Stockholm Declaration[343] and the Rio Declaration.[344] The ICJ has also referred to the principle in the milestone decision concerning the Gabčikovo-Nagymaros Project, stating that the 'need to reconcile economic development with protection of the environment is aptly expressed in the concept of sustainable development.'[345] Sustainability is a widely recognised legal principle and has been incorporated into various international agreements and initiatives, such as the UN Sustainable Development Goals (SDGs), but it does not yet have the same legally binding status as customary international law. While some aspects of sustainability, such as the duty to protect the environment or the principle of intergenerational equity, may be reflected in customary international law, sustainability as a comprehensive principle has not yet reached that level of customary recognition. However, Abate notes that it is in the process of doing so.[346]

In the realm of space colonisation, the concept of sustainability could lead to the preservation and conservation of space per se, which could be justified based on the notion of 'common heritage of mankind' and the broader concept of res communis.[347] Sustainability was introduced in the space sector at the 1999 UN Conference on Exploration and Peaceful Usage of Outer Space (UNISPACE III).[348] It encompasses the implementation of strategies aimed at mitigating the depletion of resources, the generation of space waste, and the disruption of ecological systems. Regarding space debris, sustainability is already used towards space debris mitigation. The more recent Guidelines for the Long-term Sustainability of Outer Space Activities,[349] adopted by the UN, clearly recognise the importance of sustainability for all space

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[343] See especially principles 1-5.

[344] See especially principles 1, 3-4.

[345] Gabčikovo-Nagymaros Project (no 36) 70 para 140.

[346] Abate (no 45) 188.

[347] Nico Schrijver, *Sovereignty over Natural Resources: Balancing Rights and Duties* (Cambridge University Press 1997).

[348] Mark McElroy Jr, *The Space Industry of the Future: Capitalism and Sustainability in Outer Space* 86 (Routledge 2022).

[349] UN Doc A/74/20, Annex II, Guidelines for the Long-term Sustainability of Outer Space Activities, <https://undocs.org/A/74/20>.

activities. In any case, as environmental preservation is unavoidably at odds with progress in the space sector,[350] scholars stand in favour of the application of the sustainability principle in space activities.[351] Tabas demonstrates that permanent space settlements that subsist on the extraction of extraterrestrial nonrenewable resources will also rely on sustainability[352] for effective space resources' management. In this direction, Williamson emphasises the importance of 'sustainable balance between the productive activities of mankind and the desire to retain the purity of the space environment'.[353] The incorporation of the sustainability principle within space law enables the establishment of frameworks pertaining to the prevention of unregulated mining, waste reduction, and EIAs. These frameworks will provide guidance for space colonisation projects with the aim of minimising adverse environmental effects and ensuring the sustainable continuation of space activities in the long run. In the direction of the EIAs, Martin and Freeland argue that the implementation of more sustainable policies and action plans would be an enhancement in the space sector; this is one of the goals of a Sustainability Impact Assessment (SIA),[354] which would contribute to the effective management of environmental degradation resulting from space colonisation activities. In this context, the interpretation of Article 7 of the MA should extend beyond solely conducting EIAs, and instead encompass a broader insight of the value of the lunar ecosystem. The implementation of sustainable practices is crucial in ensuring the long-term viability of lunar activities and the overall well-being of all entities involved.

The implementation of sustainable practices in the context of space colonisation holds the potential to safeguard extraterrestrial environments and facilitate the utilisation of space resources and opportunities for future generations. Bhat and D'Souza emphasise that

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[350] Hosseini, Fathpour (no 334) 397

[351] Christopher Newman and Mark Williamson, 'Space Sustainability: Reframing the Debate' (2018) 46 Space Policy 30, 34 <http://dx.doi.org/10.1016/j.spacepol.2018.03.001>; McElroy Jr (no 349); Martin, Freeland (no 242) 415; Vikaari (no 136) 144.

[352] Tabas (no 79) 2; We already see efforts towards a sustainable direction, eg the fully reusable rocket 'Starship' of SpaceX. See Paul Rinkon, 'What Is Elon Musk's Starship Space Vehicle?' (2023) <https://www.bbc.com/news/science-environment-55564448>.

[353] Williamson (no 299) 449.

[354] Martin, Freeland (no 242) 429.

sustainability incorporates the equitable consideration of both human and nonhuman interests and serves as a compromise between anthropocentrism and ecocentrism.[355] Nevertheless, it has received criticism due to its pronounced bias towards human-centric considerations.[356]

6.5. Cosmocentric critique and lex ferenda

Within the framework of space colonisation, the environmental principles of precaution, sustainability, and CBDR are frequently utilised to effectively address environmental considerations. Nevertheless, a critique from a cosmocentric perspective raises concerns regarding the extent to which these principles effectively prioritise the inherent worth and preservation of the extraterrestrial ecosystem.

In general, all three principles, derived from the Stockholm and the Rio Declaration, hold an anthropocentric orientation to a certain extent, as both documents focus on the 'human environment', excluding environmental elements that lack any discernible link to human welfare.[357] When examining these principles from a cosmocentric perspective, it becomes evident that there is room for improvement in order to more effectively correspond with a comprehensive and all-encompassing view of the universe.

Regarding the precautionary principle, although it underscores the importance of taking preventive measures when faced with uncertain risks, a cosmocentric critique contends that it fails to fully acknowledge the intrinsic value of celestial bodies and ecosystems. Rather than perceiving extraterrestrial environments solely in terms of their potential resources or suitability for human activities, a cosmocentric perspective acknowledges the intrinsic value and integrity of these environments. Hence, it is imperative to broaden the application of the precautionary principle to give precedence to the non-interference and preservation of extraterrestrial ecosystems, even in situations where potential risks are characterised by uncertainty. This

[355] Sairam Bhat and Lianne D'Souza, 'Eco-Centrism and the Right to Development: Bridging the Dichotomy' (2022) 11(1) Christ University Law Journal 35, 53-54 < https://doi.org/10.12728/culj.20.2>.

[356] ibid 54.

[357] ibid.

necessitates the adoption of a perspective of the principle that emphasises the safeguarding of celestial entities and their ecosystems as intrinsically valuable, rather than solely as resources for exploitation.

Secondly, the principle of CBDR recognises the existence of diverse capacities and historical contributions in relation to environmental issues. Nevertheless, a critique from a cosmocentric perspective posits that space colonisation frequently neglects to acknowledge the presence of imbalanced power dynamics and the possibility of exploitation. A cosmocentric perspective places significant emphasis on the importance of fair and just practices that uphold the autonomy and rights of all entities, encompassing both other-than-human beings, lifeless forms and potential extraterrestrial life. Abate also points out that CBDR in its current status encompasses a right to development which has contributed to the exacerbation of climate change.[358] Thus, enhancing the interpretation of the principle of CBDR from a cosmocentric standpoint is required. This approach will foster inclusive decision-making procedures, guarantee fair allocation of advantages, and encompass the perspectives and concerns of all pertinent stakeholders, including voiceless celestial entities and potential extraterrestrial organisms.

Finally, the sustainability principle focuses on the responsible utilisation of resources and the preservation of the outer space environment and its resources for future generations to enjoy. Sustainable development has become an established standard in the way humanity interacts with the voiceless in the Anthropocene epoch,[359] in an attempt to balance economic development and environmental protection. However, a cosmocentric critique contends that this principle frequently highlights the environmental rights of humans[360] and overlooks the wider interconnectedness within the cosmos. A cosmocentric perspective acknowledges the inherent interdependence of all elements of the cosmos, wherein actions occurring within one component can yield significant repercussions throughout the others. Therefore, it is imperative to adopt a cosmocentric ethic when considering the sustainability principle in the context of space

[358] Abate (no 46) 10.

[359] ibid 175.

[360] Ronald Kramer, *Carbon Criminals, Climate Crimes* (Rutgers University Press 2020); James Heydon, *Sustainable Development as Environmental Harm* (Routledge 2020).

colonisation, which necessitates going beyond the mere conservation of resources solely for future human exploitation. Xu characterises this perspective as the only ’ethically viable approach’ for safeguarding the global environment.[361] Moreover, the sustainability principle must consider the interests of all countries,[362], compliant to the standards of an ecocentric climate justice model. A comprehensive approach should encompass a holistic understanding of the ecological, cosmic, and cultural integrity of extraterrestrial environments, with the objective of reducing environmental disruption and giving priority to the welfare of other-than-human entities, whether terrestrial or extraterrestrial. As Xu aptly argues, ’based on the principle of sustainable development and new ecocentrism, a legally, politically and ethically viable approach for environmental protection is the only choice we can make now’.[363]

In conclusion, enhancing the tenets of precaution, sustainability, and CBDR through a cosmocentric lens necessitates a fundamental paradigm shift in our approach and engagement with space colonisation. Through the recognition of the inherent worth and interconnectedness present in the universe and the adoption of a broader understanding of the aforementioned principles, the implementation of a cosmocentric framework can offer more comprehensive and morally justifiable strategies for the colonisation of space that are in harmony with the intrinsic value of all entities within the cosmos.

7. Discussion

This thesis tackled with the research question: How can an ecocentric approach, combining cosmocentrism and environmental principles, enhance the existing international space law framework to facilitate the effective governance of space colonisation as an environmental issue? One of its objectives was to highlight the correspondence between space colonisation and the

[361] Xu (no 56) 5.

[362] Yun Zhao, 'Emerging Approaches in Development Efforts: Chinese Perspective on Space and Sustainable Development' (2018) Yearbook on Space Policy 265, 279 <http://dx.doi.org/10.1007/978-3-319-72465-2_15>.

[363] Xu (no 56) 5.

protection of the environment. Secondly, it aimed at emphasising the significance of the adoption of a cosmocentric ethic to address the environmental implications and ethical dilemmas arising. Lastly, it focused on putting forward the need for a cosmocentric interpretation of the current space law framework, investigating reasonable solutions towards this goal. To accomplish this, a combination of doctrinal and critical methods was used; existing legal instruments were applied to adopt an environmentally friendly interpretation of international space law, and the latter was examined through a cosmocentric lens.

The discussion section of this thesis will encompass the key findings and their implications regarding the research question. Firstly, it will provide a concise overview and interpretation of the main findings. Then, it will point out the added value of this research despite its limitations. Finally, it will outline potential avenues for future research.

This research argued that a cosmocentric ethic will effectively approach space colonisation as an environmental issue. By providing a broader examination of the ethical dilemmas arising from space colonisation and the potential human rights violations, it demonstrated the relevance of an ecocentric approach and indigenous perspectives in addressing the multifaceted ethical challenges associated with space activities. This perspective places intrinsic value on celestial bodies, acknowledges the interdependence between humans and the cosmic ecosystem and promotes the responsible stewardship of the environment.

Through the analysis of international space law treaties, this thesis concluded that the current framework has limitations in addressing environmental concerns and ensuring ethical practices in space. The inadequate environmental provisions and the ethics currently underlying the law emphasise the need for a comprehensive revision. The thesis proposed the application of the environmental principles of precaution, sustainability and CBDR, which will strengthen the international space law regime to address the potential ecological impacts of human space settlements. However, a cosmocentric critique of these soft law principles showcases that there is room for improvement.

Compared to previous research presented throughout the thesis, this analysis provides a comprehensive view of space colonisation as an environmental issue. The primary findings

indicate that a cosmocentric interpretation of space legislation is needed to achieve the safeguarding of the terrestrial and extraterrestrial environment for their own sake. By merging cosmocentrism, environmental principles, indigenous perspectives and considerations of human rights in light of the Anthropocene era, this thesis paved the way for a more inclusive and ethically grounded approach to space colonisation. In this context, human rights violations will be prevented long term, as opposed to the temporary remedies anthropocentrism offers.

Regarding the legal analysis, the incorporation of space law and environmental principles offers a prompt but effective way of managing the potential ecological implications of space colonisation activities. The need for regulation is urgent, as plans for establishing permanent human habitats in outer space are already in the works. Humankind has caused disastrous consequences in the Earth's environment; thus, this thesis suggests a paradigm shift in the ethics underlying law, and a corresponding interpretation of the main space treaties, to refrain from causing equally destructive environmental consequences in outer space.

Regarding the limitations mentioned in the Introduction, suggestions for future research could be made. As enhancement of the space law framework through the application of environmental principles appears feasible (as was argued in Chapter 6), future studies could focus on the establishment of effective enforcement mechanisms. In the absence of the latter, international law is dead letter. Therefore, research can be conducted on ways in which enforcement measures or legal entities can be put in place, to ensure ethical and environmentally friendly practices in space. In this way, implementation of the proposed interpretation of the space treaties would be ensured, instead of staying in the realm of theory. Furthermore, the evolving nature of space activities requires ongoing research. As technology advances and new ventures emerge, ethical challenges will continue to arise. Hence, future research might need to revisit the research question and modify it to remain topical and ensure the continuous development and improvement of the governance framework.

In summary, the discussion section concluded the study by highlighting the key findings in relation to the research aims and questions. This thesis argued that a cosmocentric ethic will effectively address space colonisation as an environmental concern. Moreover, the application of

environmental principles to the current space law framework offers a prompt but effective way of managing the potential ecological implications of space colonisation activities. Finally, this thesis suggests a paradigm shift in the ethics underlying the current international space law framework, and a corresponding interpretation of the main treaties, to safeguard the environment per se and the rights of the voiceless, and achieve balance between human beings and the cosmic ecosystem.

8. Conclusion

Environmental degradation, mainly evident through the complex issue of climate change, is one of the biggest challenges humanity is currently facing. The present Anthropocene era is characterised by a significant environmental crisis caused by human activities that have altered Earth's climate and ecosystems. As humans venture into outer space, safeguarding the global environment becomes even more imperative.

As humans and the environment are interdependent, environmental degradation results in human rights violations, and the protection of the environment is crucial for the enjoyment of human rights. The anthropocentric model has failed to effectively address the challenges posed by climate change. One could not even imagine the colossal environmental consequences humans would cause if they rushed their space colonisation plans. Thus, the future requires us to redefine the role of humans in the cosmic ecosystem and challenge the prevailing dominance of humans in the present era.

This requires a comprehensive approach that considers not only legal and ethical aspects but also incorporates the perspectives of indigenous peoples. Indigenous worldviews have long demonstrated deep respect for the environment and can provide valuable insights into sustainable relationships with natural and celestial resources. A cosmocentric model would safeguard the rights of nature, other-than-human animals and future generations, while benefiting humankind long-term, as it would promote a sustainable way of living, in harmony with the environment.

The current legal systems, primarily in the Western world, are predominantly centred around human interests. In the New Space era, States have the option to align with environmentally sustainable practices, ensuring ethical activities in space, or choose to invest in rushed space advancements without considering the environmental impact. The latter will inevitably reinforce environmental degradation and hinder the enjoyment of human rights. Moreover, the interests and needs of developing nations should be considered, in accordance with an ecocentric model of climate justice. This would ensure the equal participation of all countries in decision-making in the space sector and compel the spacefaring nations to accept responsibility for environmental destruction.

After exploring the current international space law framework, I suggested that the current legal regime fails to address the potential environmental challenges brought by the establishment of permanent human settlements in space. Given the critical importance of safeguarding the global environment, this thesis has explored the potential of an ecocentric approach to enhance the existing international space law framework for effective governance of space colonisation as an environmental issue. By integrating the intrinsic value of celestial bodies and recognising the interdependence between humans and the cosmic ecosystem, an ecocentric perspective offers a promising pathway towards sustainable and responsible space activities.

First, this research aimed at providing context by briefly discussing the ecological impact that humans have caused in the age of the Anthropocene. It demonstrated how the environment and human rights are interdependent and emphasised the need for an ecocentric model of climate justice in the governance of space activities. Such a model would consider the rights of nature movement as a guide. Second, it presented current plans for building permanent human colonies in outer space, investigating the grounds for such plans. It pointed out the irony that colonising space is often presented as a solution to escape environmental degradation on Earth, while it may cause further and potentially more severe environmental consequences. This study also sought to present the breaches of human rights, the ethical dilemmas and the repercussions for the environment that such plans might lead to.

Thirdly, this research studied the principles of astroenvironmentalism. It argued for a cosmocentric approach as a means of analysing space colonisation, based on intra- and intergenerational ethics, as well as the perspectives of indigenous peoples. The latter could provide valuable insight, as many indigenous communities have deep connections to the sky and live in harmony with nature, something Western legal systems lack. On this note, it investigated the current international space law, concentrating on the legality of space colonisation and the notion of 'common heritage of mankind'. It also examined the environmental provisions found in the primary treaties, identifying the legal gaps, and argued that the current legal framework is inadequate to address the potential environmental implications of space colonisation.

Finally, this thesis examined the likelihood of filling the legal gaps in the existing framework for international space law with the environmental principles of precaution, CBDR and sustainability. De lege lata, it argued for the possibility of such an application. Simultaneously, it provided a critique via a cosmocentric lens and, de lege ferenda, it argued for the preservation of the environment per se. By embracing such an approach, humankind can pave the way for space activities that respect the celestial environment, foster harmony with indigenous cultures, and ensure the long-term preservation of celestial ecologies for the benefit of present and future generations.

As Marino aptly puts it, we are not prepared to 'be a "multi-planet species" but we can use this knowledge to try to make a go of it on the one planet that we have any chance of thriving on — earth.'[364] Now more than ever, an ecocentric ethic needs to be merged with law, and promote an ongoing interdisciplinary collaboration between the two disciplines. By doing so, the resulting governance framework will benefit from diverse perspectives, foster cultural diversity, and contribute to a more inclusive and just approach to space colonisation. Environmental ethics can provide a moral framework for international law to address space colonisation as an environmental issue. Ethical principles can guide the development and implementation of international space law, in accordance with the evolving nature of space activities. This thesis has explored the complementary nature of these two disciplines, highlighting how their fusion can

[364] Marino (no 100) 19.

strengthen the legal framework for environmental protection beyond the terrestrial boundaries. By merging international law with environmental ethics, a deeper understanding and appreciation of the intrinsic value of nature could be achieved, prioritising long-term ecological well-being over short-term financial gains. Moreover, the incorporation of ethical considerations into the framework of international space law strengthens its normative foundation. Ethical principles provide a moral compass for understanding and applying legal standards in a manner that aligns with the core concepts of sustainability, intra- and intergenerational equity. Furthermore, environmental ethics can help to promote climate justice by ensuring that the interests of marginalised communities are taken into account, reinforcing the participatory nature of decision-making processes.

Overcoming the pervasive anthropocentric biases that are deeply embedded in legal systems necessitates a collaborative endeavour involving policy makers, legal professionals and scholars. The integration of ethical issues necessitates thorough deliberation to strike a balance between normative ideals and practical feasibility, thereby guaranteeing that ethical principles enhance legal effectiveness towards an ecocentric direction. In summary, the integration of international law and environmental ethics presents a potentially fruitful and promising avenue for achieving equitable and more holistic global environmental governance. As the world faces increasingly complex environmental challenges in light of the technological advancements and the ever-evolving progress of the space sector, this interdisciplinary approach becomes not merely an academic pursuit but a moral necessity for the global community.

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