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## Indigenous cosmic caretaking and the future of space exploration

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Centre for International  
Governance Innovation

CIGI Papers No. 305 – September 2024

# Indigenous Cosmic Caretaking and the Future of Space Exploration

Karlie Alinta Noon







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## About the Author

**Karlie Alinta Noon** is an Aboriginal woman from the Gamilaroi Nation in eastern Australia with degrees in math, physics and astrophysics and more than a decade of expertise in science communication. Karlie uses her experience in Indigenous heritage and STEM (science, technology, engineering and math) education to integrate Indigenous knowledges and values within space and astronomy practices.

Karlie is the co-author of the acclaimed book *Astronomy: Sky Country* and is currently pursuing a Ph.D. in astrophysics at the Australian National University. Her research utilizes radio telescopes and simulations to delve into the chemical evolution of gas clouds entrained within the Milky Way's nuclear wind.

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## Executive Summary

Cosmic caretaking highlights the importance of fostering meaningful collaboration grounded in the principle of sustainable environment caretaking. The findings of this paper emphasize the significance of preserving and protecting celestial environments through Indigenous-led astro-environmentalism and conservation efforts. It underscores the need for respectful relationships between space agencies, research institutions and Indigenous communities, supporting a culture of co-creation and co-management to address environmental impacts, ethical activities and heritage preservation.

There is a clear need for the development of protocols for engaging Indigenous peoples in space activities, aligning with Indigenous values and practices. Such a protocol should emphasize equal opportunities for Indigenous communities to learn, participate and benefit from space science, technology and careers, contributing to Indigenous economic growth and self-determination. Further, there is a pressing need for different state nations to either ratify existing treaties or establish new ones to prevent astro-colonialism.

The findings of cosmic caretaking emphasize the importance of embracing Indigenous-led initiatives and prioritizing inclusivity to forge powerful partnerships that promote environmental stewardship, honour Indigenous sovereignty and advance our collective presence in the cosmos.

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## Introduction

The ancient wisdom and timeless narratives of Indigenous cultures offer a profound perspective on humanity's relationship with the cosmos, predating modern space exploration by millennia. These communities stand as living testaments to humanity's earliest encounters with the cosmos, tracing their lineage back to the very first stargazers who have documented, sung, danced and retold the wonders of the night sky for generations. From captivating tales of cosmic cycles to profound observations on the interconnectedness

of all things, Indigenous traditions offer a rich tapestry of wisdom and sustainable practices.

In contrast to the relatively recent advancements and goals of modern space exploration, Indigenous peoples have been intimately connected to the celestial realm since time immemorial. Despite this longstanding connection and the increase in widespread interest in the cosmos since the 1960s space race, Indigenous perspectives remain largely sidelined in today's technologically driven industry. Indigenous knowledge, including sky, land, seasonal and environmental knowledge, can inform modern practices when engaging with space.

These narratives not only offer valuable insights into the mysteries of the universe, but also serve as living records of humanity's enduring relationship with the cosmos. A wealth of knowledge and wisdom that could enrich humanity's presence in space is at risk of being lost by overlooking Indigenous perspectives. Recognizing the invaluable contributions of Indigenous peoples to the collective understanding of the cosmos is not just a matter of historical redress; it is a pressing necessity for humanity's collective future.

While standing on the cusp of unprecedented space endeavours, from lunar missions to Mars colonization, humanity must heed the call to incorporate Indigenous perspectives into the very fabric of its cosmic goals. Embracing Indigenous knowledge systems represents a more inclusive and holistic approach to space exploration that honours the diversity of human experience and fosters a deeper connection to the universe that is home.

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## Indigenous Knowledge Systems and Traditional Practices

Western knowledge systems and Indigenous traditions offer distinct approaches to understanding the world. While Western systems often compartmentalize knowledge into discrete facts, Indigenous oral traditions integrate knowledge within the fabric of culture, lore and law. In Australia, the Dreaming — a concept that transcends time, space and place — exemplifies



this holistic approach for Aboriginal and Torres Strait Islander peoples. Central to the Dreaming are Songlines or Song Spirals, sacred narratives documenting the land and its relationships. As explained by the Bawaka group: “Songsprals are sacred songs, stories, and ceremonies. They are about knowing Country, singing the land, the sky, and the heavens. They are a deep mapping of the land and its many relations, above and below, around, in many layers and dimensions” (Bawaka Country 2023, 218). For example, the Seven Sisters Songline is one of the most significant as it connects communities from the east to west coasts of Australia, spanning a distance of 4,000 km. The Songline describes the journey of Seven Sisters, as represented by the Pleiades constellation, as they flee from a pursuer, represented by the Orion constellation. In this Dreaming, the sisters attempt to escape the hunter, while describing the creation of features in the land. This Songline captures the motions and positions of the two constellations and is believed to be one of the oldest stories known by civilizations transcending across languages, continents and eons of time (Norris and Norris 2020).

Throughout this Songline, the sisters are said to shape the landscape as they flee, leaving behind significant landmarks and sacred sites important to different communities. These sites hold deep spiritual and cultural significance for Indigenous communities who are part of this Songline tradition, with different communities responsible for different parts of this particular Songline.

The Seven Sisters Songline is not just a story but also a living cultural map, guiding Indigenous peoples across the land, giving them access to specific sites often located in neighbouring Indigenous lands. Songlines connect people to Country, ancestors and one another. Through song, dance, storytelling and ceremony, Indigenous communities preserve and transmit their wisdom and knowledge from generation to generation. Songlines serve as a profound expression of cultural identity, spiritual connection and ecological stewardship, embodying the intricate relationships between people, land, sky and spirit in Indigenous cosmology.

Indigenous peoples’ profound connection to the land infuses every piece of knowledge with purpose. Across generations, this knowledge is not merely transmitted but treated with the utmost importance through sacred rituals of

storytelling and ceremony. In oral cultures where wisdom is passed down through generations via narratives and communal rites, memory and oral traditions offer invaluable knowledge. Remarkably, Indigenous knowledge holders demonstrate the most skilled feats of memory, as exemplified by individuals such as Wardaman Traditional Owner Bill Yidumduma Harney, who possesses a photographic understanding of every visible star, tracing these stellar celestial journeys and weaving them into rich Dreamtime narratives (Norris 2016).

The Aboriginal and Torres Strait Islander peoples of Australia have always acted as custodians of their lands, navigating significant environmental fluctuations with profound adaptability. A prime example lies in the Quinkan cultural landscape of the Cape York Peninsula, where communities have thrived amid dramatic changes. Dating back 47,000 years, this region serves as a testament to Indigenous adaptation strategies, notably during the sudden rise in sea levels approximately 20,000 years ago. This event led to the loss of significant land, including a land bridge connecting Australia and Papua New Guinea, now known as the Isles of the Torres Strait. Despite these challenges, Indigenous communities leveraged their deep understanding of the environment to successfully navigate this shift.

The extensive rock art galleries within the Quinkan landscape offer tangible records of adaptation and cultural evolution. These artworks reflect the introduction and integration of new cultural elements, technologies and socio-cultural practices over millennia. Such examples highlight the capacity of ancient civilizations to constructively engage with shifting landscapes and populations, providing valuable lessons for modern societies grappling with similar challenges, such as climate change and global migration.

Indigenous culture is deeply intertwined with the natural world, as demonstrated by practices such as cool burns. These controlled burns, which are only carried out based on observations of the land and sky, showcase the intimate relationship between sky observation and land stewardship. While facing the challenges of escalating climate change, contemporary society increasingly looks toward Indigenous culture for sustainable land management practices that have endured the test of time. As environmental crises escalate and humanity ventures into the unknown,

the importance of a harmonious coexistence with nature becomes ever more apparent.

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## Celestial Narratives

Native communities have gazed at the skies, pondering celestial bodies and space phenomena since time immemorial. While modern studies of celestial phenomena have become the domain of specialized scientists, Indigenous life once demanded that all community members possessed an intimate understanding of the sky. From tracking the movements of prominent celestial bodies, to discerning subtle atmospheric signals for weather shifts, to enacting ceremonial rituals symbolizing journeys through space, sky knowledge was an intrinsic aspect of traditional Indigenous life and is still an integral part of modern Indigenous culture.

In the rich tapestry of oral cultures, Indigenous communities embed important locations, landmarks, animals, plants and even celestial objects with unique meaning and narratives. These associations served uncountable practical purposes: enabling navigation across vast distances, distributing knowledge to ensure collective responsibility, monitoring weather patterns and seasonal changes and interpreting the land itself.

The section that follows delves into the celestial narratives woven by Indigenous communities to depict significant times, places and people in the sky. Through sharing these stories, the aim is to illuminate the enduring traditions deeply embedded within Indigenous cultures, as well as Indigenous peoples' profound connection to Country.

### Creation Stories

Indigenous creation stories often refer to a time when the land and sky were much more closely bound. In one such Dreaming, the sky hung so low that it cast a darkness over the Earth, forcing people to grope in the shadows in search of food and water (Mountford 1976). Other narratives describe a pivotal moment when the sky and Earth parted ways. For instance, anthropologist Charles Percy Mountford (*ibid.*) describes how during this time, the land was overcome by complete darkness until the diamond firetail bird created the sun,

bringing light to the land. In Nyungar stories from Western Australia, magpies are responsible for the parting of land and sky, as it is told that they came together to raise the sky with sticks and boulders until it cracked open, revealing the first sunrise. A similar story from the Gamilaroi tells of the brolga, a crane-type bird, who was having an argument with an emu, a native flightless bird, when the brolga hurled an emu egg into the sky, shattering its yolk on fire sticks, which subsequently erupted, igniting the world's first light (*ibid.*).

In a Gamilaroi story, a community leader called Yondi is said to have bathed in a magic pool, making him grow. In his larger form, he takes a branch from the magic pool and uses it to lift the sky. The branch then becomes the first boomerang (Eggleston 1963). Once the sky was elevated, a new era of light and abundance dawned. According to the legend of Yondi, before the sky's ascension, people were as small as ants. It was only after the lifting occurred that water from magic pools arose, forming clouds that showered the land, causing both people and animals to grow to their present size. In other accounts, cultural heroes like the Father of Creation (Buwadjarr/Baayina) or the Rainbow Serpent are said to have orchestrated the separation of land and sky. In addition to the separation, these celebrated figures are also believed to have crafted significant places that are mirrored in both land and sky.

### Places

Significant places hold a profound importance in Indigenous cultures, serving as repositories of richly layered and interconnected knowledge. Knowledge stored in physical locations underscores the intentional preservation of knowledge in oral traditions and emphasizes the profound interrelatedness of all elements of traditional life. When it comes to significant places in the sky, Mountford describes how Aboriginal communities perceived the sky world as a realm with "an abundance of food, good weather, comfortable camping places, and a community of old friends, all of whom are at peace with each other" (Mountford 1971b).

Among the celestial features revered by Aboriginal and Torres Strait Islander nations, the Milky Way takes precedence. Its distinctive appearance, marked by pools of luminous light interwoven with dark dust lanes, makes it one of the most noticeable features in the Southern Hemisphere's

sky. For many Aboriginal and Torres Strait Islander cultures, the Milky Way symbolizes a cosmic river teeming with life. Within this celestial river, creatures such as turtles and fish thrive, providing sustenance for the ancestors who inhabit the sky. The luminous pools flanking the river are believed to be fireplaces used by celestial beings for cooking their catch. Other creatures also exist in the river in a state of stasis, never to be eaten or move on to other waters. In the Gamilaroi sky, two crocodiles can be seen in the dark pools of the Milky Way, said to remain there forever after betraying Baayina, the Father of Creation, after they ate two of Baayina's wives. Baayina is said to have freed his wives after killing the crocodiles and sentencing them to a life dedicated to protecting sacred women's grounds. Baayina sentenced the crocodiles to never enter the place that lives beyond the river, so that they are forever confined to the river to serve as a reminder to listen to the Elders (Fuller, Norris and Trudgett 2014).

The realm beyond the Milky Way, often referred to as Sky Camp, holds profound significance as the final resting place for initiated individuals. It is believed to be where people reunite with their ancestors in the afterlife. Some communities suggest that the ethereal trails of light emanating from the Milky Way are smoke serving as beacons for spirits, leading them back to their celestial home (White 1904). For the Yolngu people, the messenger bird Guwak plays a pivotal role, facilitating the journey between land and sky through its distinctive calls, reinforcing the connection between terrestrial and celestial realms and aiding spirits on their final journey (Bawaka Country 2023).

Similar narratives exist in Indigenous epistemologies worldwide. The Nishnaabeg Ojibway peoples say that the Nishnaabeg "are born from the skyworld" and that they "return there when [their] time in the physical world is done. The spirits live there. Knowledge is held there. One of the primary responsibilities and beautiful struggles of physically being Nishnaabeg is that [they] have to strive and commit to maintaining deep everyday relationships with this world when [they] are physically on the Earth" (Simpson 2017, 211-12). The profound importance of these celestial sites and the wisdom they contain underscores the urgent need to preserve access to them. Yet this link to humanity's ancient knowledge faces an ever-increasing threat: the invasion of light pollution and astro-colonization.

## People

Aside from the significant places associated with Sky World, as described above, there are many people, ancestors and cultural heroes who reside in the sky. In fact, the sky is believed to be so populated that it is said that all of "the stars were formerly men, who came out from their huts in the evening" (White 1904). Certain creation heroes, such as Baayina or Daralulun, are believed to have taken residence in the sky when their jobs on the land were complete (Mountford 1971a). On Groote Eylandt in northern Australia, the Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC), two satellite galaxies visible in the southern sky, are the camps of two Elders who are looked after by the other star beings (Hulley 1998). For the Gamilaroi, the SMC is known as a Wiringin, or "clever man," whose job it is to direct the initiated and non-initiated people, sending the initiated to Sky Camp and the non-initiated back to Earth to be reborn.

In Indigenous traditions, the Moon holds great significance as a cultural hero. Despite largely being regarded as a man across Indigenous cultures, the Moon-Man is frequently intertwined with concepts of femininity, fertility and womanhood. As Charles Hulley (ibid., 9) writes in his book *Dreamtime Moon*, "from Australia and New Guinea to Alaska, the moon was husband to all women." This association stems from the Moon's 29.5-day cycle, referred to as "nature's clock," and closely aligns with the approximate 28-day human fertility cycle. Consequently, the Moon and its phases are commonly believed to control fertility and childbirth. This means different things to different nations. For example, some groups believe that it is largely forbidden for women to look directly at the Moon-Man as they fear that it could make them infertile. Conversely, the Yolngu believe that looking at the full Moon would cause a woman to fall pregnant (Bhathal 2009). A Gamilaroi/Euahlayi belief says that the Moon "had such an important role to play in the birth of a child that mothers were careful not to offend him. If they stared at the moon, Bahloo would be annoyed and would send them twins" (Reed 1998, 131). But the Moon-Man is not the only one responsible for making babies. Wadhaagudjaaylwan, the wife of Baayina, the Father of Creation, lives in the LMC and is responsible for "send[ing] the child's spirit on the rays of the Moon" (Langloh Parker 1905, 73), with help from Wahn the Crow (Fuller 2014).

The Moon is also a significant figure in Indigenous culture regarding rebirth. Many nations describe the Moon dying and coming back to life. For the Yolnu people of northeast Arnhem Land, the Moon is a man called Ngalindi who is responsible for the changing tides each day. When Ngalindi rises into the sky, he fills up on water from the ocean as he passes the horizon. He empties himself of all the water when it is time for the Moon to set, explaining high and low tides. However, Ngalindi is known for his gluttony and takes on too much water, making himself fat. Unimpressed with his fatness, his wives chase and attack him, chopping off pieces of his flesh as he tries to flee. Eventually, Ngalindi escapes his wives by climbing a tall tree. It is said that he attempts to leave his wives to follow the sun, but he has usually suffered too much damage from them and dies. After three days, Ngalindi emerges from the dead and with his newly found life, he returns to his old gluttonous ways, consuming until he becomes fat again and his wives once again attack him. Very occasionally in Ngalindi's cycle, the Sun-Woman Walu manages to capture him, and they join for an embrace for a brief moment in time, explaining the rare occurrence of an eclipse (Wells 1964).

In another story told by Mountford, the Moon-Man is said to be quarrelling with the parrotfish. The Moon-Man is so infuriated that he declares all living things are never to be allowed to return to life once they die. True to his own word, the Moon-Man also has to die, although his death lasts only for three days. It is believed that "the skeleton of each dead moon drops into the sea and becomes the empty shell of the chambered nautilus" (Mountford 1971a, 16). At a time when society is endeavouring to alter the Moon's natural state, it is imperative for the global community to recognize the profound disrespect these missions could represent for Indigenous communities, as well as the harm that could befall Earth's only natural satellite.

## Space Travel

Indigenous groups worldwide have countless stories of space travel or instances where the land and sky are physically connected. This belief is so common across Australian Aboriginal nations that avenues connecting land and sky were viewed as highways in which people could regularly come and go, for the purposes of trading or hunting, between the two spaces (Mathews 1905).

For the Tiwi people in northeast Arnhem Land, rain was seen as a mediator between the land and sky, carrying the spirits of Sky World to the land where they feed and live in the plants (Mountford 1958). During creation times, some ancestral spirits are said to have been caught up in a whirlwind, carrying them up into the sky where they became the gods and goddesses of Sky World (Reed 1998). For the Kulin people in southern Australia, spirits are believed to enter Sky World through the rays of the setting sun (Elkin 1994). In one story, several men climbed to the tallest peak and flew into the sky to escape fire, becoming the Pointer Stars to the Southern Cross (Mountford 1976). For the people of the Kimberleys on the west coast of Australia and the Wik-Mungkan people on the east coast, a rainbow could connect the people of the land to those in the sky (Elkin 1994; McConnel 1957); for other nations, a cord or hair connected them to Sky Country.

Across several nations, including the Wotjobaluk, Alawa and Dja Dja Wurrung peoples, large trees such as pines and stringy barks were viewed as bridges to the Sky World. In one of the many Gamilaroi versions of the infamous Seven Sisters odyssey, the sisters are known for their beauty and bodies made of icicles. The old fire spirit, Wurrannah, decides to steal two of the sisters to warm his icy body. However, the chill of the sisters overcomes the warmth of Wurrannah's body, and his flame is extinguished. Determined to punish them, he orders the sisters to gather bark from a great pine. The sisters, however, are aware of the tree acting as a portal between land and sky and begin to cut the bark. Soon after, they rise into the sky, reunited with their other sisters, but with their light dimmed from Wurrannah's attempt to warm them (Langloh Parker 1896). In Dja Dja Wurrung Country in southeastern Australia, a large pine tree acts as a portal between land and sky in a similar way to that described in the Seven Sisters story (Mathews 1905).

Other portals could come and go, depending on the weather. For example, the Gamilaroi could access Sky World through a portal known as the Big Warrambool, a large floodplain that would become a portal when there had been sufficient rain in the region. During the wetter seasons, the floodplain fills with water that reflects the Sky World above at night. The Big Warrambool runs through the land down below, mirroring how the river runs through the Milky Way up



above and also acting as a bridge connecting the two worlds (Fuller, Norris and Trudgett 2014).

Sometimes the Sky World gods would call upon people to leave the land and enter Sky Country: “Pund-jil knew who were good and who were bad. The good ones he saved. He called on the wind to carry them up into the sky where they became stars” (Reed 1998, 12). The Dieri people of the Lake Eyre region believed the sky ancestors would unfurl their hair, dropping it to the ground, in the event that people from the land were needed up in the sky (Elkin 1948).

There are similar stories in other regions of the world. The Hopi nation in Arizona speak of ancient star kin called Kachinas who are described by Hopi descendants as “the spirits of all things in the universe, of rocks, stars, animals, plants, and ancestors who have lived good lives” (Pritzker 2011, 26–27). During ceremonies, the Hopi construct ladders for the Kachinas to climb down from the Sky World to join people on the land (Praet 2023). Hopi ladders are also a means for Hopi to escape to the sky realm if necessary, acting as a means to travel off-world as modern spacecrafts and rockets are used today (ibid., 2023). The ladders have also been used by the Hopi since creation times, as it is said that they first emerged out of the underground using these same ladders. The Hopi ladders not only connect people to the Sky World and their kin, but also to their creation times and ancestors. Many Indigenous communities have experienced a deep connection with celestial realms and the idea of space travel over generations, offering a stark juxtaposition to the remote, disconnected portrayal of outer space often depicted in contemporary space studies. As a group of Inuit people featured in M. Jane Young’s (1987, 272) essay, “Pity the Indians of Outer Space,” remark: “We do go to visit the moon and moon people all the time. The issue is not whether we go to visit our relatives, but how we treat them and their homeland when we go.” Embedded within the historical and cultural fabric of Indigenous peoples are profound experiences of space, offering invaluable insights that could significantly enrich modern practices within the space industry.

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## The Modern Space Industry from an Indigenous Perspective

Indigenous cultures, knowledges and peoples bring crucial viewpoints to endeavours such as space exploration, drawing from centuries-old histories, creation stories and time-honoured cultural teachings. These invaluable perspectives stand in stark contrast to the unsettling familiarity of the astro-colonialism that is currently unfolding.

The pressing existential threat that humanity is currently facing is being used to justify colonial expansion into space. Issues such as over-consumption and climate change illustrate the unchecked growth that threatens humanity’s long-term survival (Elvis and Milligan 2019), with resource demands currently requiring about 1.75 times Earth’s resources in order to keep up with demand.<sup>1</sup> The unsustainable consumption of non-renewable resources to sustain the ever-expanding human population exacerbates income inequalities and threatens access to vital resources such as food and water, a problem that has worsened since 2020. As Karlie Alinta Noon et al. (2023, 239) pointedly ask, “What guarantee is there that our mismanagement of resources won’t follow us into the cosmos? If the best predictor of future behaviour is past behaviour, what qualifies us as a species to colonise other celestial bodies?”

For centuries, the world has had to reckon with the ongoing consequences of colonization. Indigenous communities have faced drastically lower socio-economic status, disproportionate representation in the justice system, increased health problems and significantly lower life expectancies compared to their settler counterparts, and the loss and devastation of their traditional lands. For example, despite housing some of the world’s richest biodiversity, Australia has experienced unprecedented rates of animal extinction due to colonization-driven factors such as introduced species and farming. The devastating bushfires of 2020 exacerbated this situation, resulting in an estimated one million animal deaths. As Hispanic and Mexican researcher David Delgado Shorter

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<sup>1</sup> See [www.footprintnetwork.org/](http://www.footprintnetwork.org/).



(2021, 20) astutely observes, “In almost every contact situation with Europeans, the Indigenous people of the Americas [have] suffered disease, wide-scale death, cultural disruption, and often community destruction and/or displacement.”

Colonial practices have come at a great cost to Indigenous peoples, as well as to many native creatures and plant forms. And, yet, despite the known consequences of these practices, the space industry is at risk of repeating similar harms both on Earth and on other worlds. In 2020, US President Donald Trump gave a speech that uncannily celebrated colonial conquest, emphasizing American dominance in space exploration: “I am asking Congress to fully fund the Artemis program to ensure that the next man and the first woman on the Moon will be American astronauts — using this as a launching pad to ensure that America is the first nation to plant its flag on Mars. Our ancestors braved the unknown, tamed the wilderness, settled the Wild West....This is our glorious and magnificent inheritance. We are Americans. We are pioneers. We are the pathfinders. We settled the New World. We built the modern world” (Trump 2020).

As the ethical dilemmas surrounding space exploration unfold, Indigenous voices raise further concerns about the accumulation of Earth’s resources by the world’s wealthiest individuals under the guise of humanity’s salvation. Rather than directing his wealth toward bettering Earth’s conditions, Elon Musk, one of the planet’s richest people, retorted with a callous dismissal of his home planet when confronted with the pressing issues of inequality and climate change: “fuck Earth” (quoted in Andersen 2014; Rubenstein 2022). His focus, it seems, lies solely on his ambitious plan for terraforming Mars, and not on the unfair, yet avoidable, conditions faced by many people here on Earth. Similarly, billionaire Jeff Bezos imagines a future focused on consuming without limits, even beyond Earth: “I want my great-great-grandchildren to be using more energy per capita than I do. And the only way they can be using more energy per capita than me is if we expand out into the solar system” (Davenport 2019). Bezos presents an unnerving vision predicated on unsustainable and relentless expansion into the cosmos. But in their imaginings of humanity’s future, two of the richest people on Earth do not consider the sustainability of their interest in space.

This lack of consideration for sustainability has led to an intensification of existing threats to

dark skies and unpolluted near-Earth spaces in the form of megaconstellations. The goal of megaconstellations is to provide high-speed, low-latency internet across the entire planet, leaving no place untouched. As stated by SpaceX’s company president, Gwynne Shotwell, “We hope after about 28 launches we’ll have continuous coverage throughout the globe, and then the plan after that is to continue to add satellites to provide additional capacity. We will do some polar launches starting this summer to get connectivity over the poles as well” (quoted in Brown 2021). As satellite approvals surge and injections multiply, an already congested outer space is becoming increasingly overpopulated. This trajectory sparks mounting concerns about orbital congestion and its repercussions. Astronomer Aparna Venkatesan and her co-authors warn that “the manner and pace of ‘occupying’ near-Earth space raises the risk of repeating the mistakes of colonization on a cosmic scale” (Venkatesan et al. 2020, 1043; see also Bawaka Country 2020; Traphagan 2019; Williams 2010).

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## Indigenous Cosmologies versus Western Space Narratives

The contrast between Indigenous and Western perspectives on outer space sheds light on divergent world views and their implications for humanity’s understanding of the cosmos. As aptly pointed out by Ojibwe Indigenous geographer Deondre Smiles (2020, para 3), “scientific venture such as space exploration does not exist in a vacuum, but instead draws from settler colonialism and feeds back into it through the prioritization of ‘science’ over Indigenous epistemologies.” In Western discourse, the term “outer space” has been prevalent since H. G. Wells’s novel, *The First Men in the Moon* (1901). Over time, this term has become deeply ingrained in Western vocabulary, subtly implying a disconnection between Earth and the cosmos. Similarly, exoplanets are often labelled as “new worlds,” echoing the language of European colonialism (Messeri 2016). While seemingly innocuous, these terms carry significant historical baggage. For example, “new world” was the term European explorers employed to describe

the Americas in the sixteenth century, signalling an era of colonial conquest and domination over those regions. Christopher Columbus famously declared that the lands he encountered were a “new heavens and world,” placing them under the dominion of European powers (Major 1870, 170). This mindset fuelled the colonization of territories such as the United States at the expense of Indigenous peoples who had inhabited these lands for millennia. This parallels the notion of *terra nullius* in Australia, a legal concept used by British colonizers to justify the seizure of Aboriginal land, thereby denying Indigenous humanity and sovereignty. Similarly, in the United States, the Supreme Court’s decision in *Johnson v. McIntosh* (1823) established the doctrine of discovery, which asserted that Indigenous lands could be claimed by European settlers, denying Native American tribes their property rights.

Indigenous voices offer an alternative view of space. The Bawaka Group from Australia’s Arnhem Land reject the notion of “outer space,” saying instead that: “Country includes lands, seas, waters, rocks, animals, winds and all the beings that exist in and make up a place, including people. It also embraces the stars, moon, Milky Way, solar winds and storms, and intergalactic plasma. Land, Sea and Sky Country are all connected, so there is no such thing as ‘outer space’ or ‘outer Country’ — no outside. What we do in one part of Country affects all others” (Bawaka Country 2020, 2). As explored in the cosmic narratives section, Indigenous cultures worldwide see space as populated by familiar beings and places, fostering kinship and connection. Hopi pilgrims navigate a cosmos filled with recognized entities, while Inuit people acknowledge their visits to the Moon and its inhabitants. For Indigenous communities, Sky Country is a known, mapped and cared-for place, indifferent to Western laws or sciences.

Unfortunately, the space industry has largely overlooked Indigenous perspectives, instead perpetuating a colonial approach to exploration. Anthropologists such as Valerie Olson (2023) and William Lempert (2021) highlight the industry’s failure to incorporate Indigenous knowledge by favouring the concept of a *cosmos nullius*, leading to what is termed “astro-colonialism.” Lempert points out that Indigenous epistemologies are essential in modern times to challenge colonial assumptions within scientific fields; the ongoing exclusion of Indigenous epistemologies from scientific discourse perpetuates colonial ideologies and impedes the

industry’s progress. As Shorter (2021, 21) warns: “We are now in the middle of a story about the next arena for colonialism: space, the final frontier.”

Here there is great opportunity for change. Centring Indigenous perspectives can guide a more ethical and inclusive approach to space exploration, challenging colonialist paradigms and benefiting all humanity. As Wahpetunwan Indigenous scholar, Waziyatawin (2008, 168) remarks, “we need to consider a dramatic rethinking of the way we exist in this world.”

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## Space Law

The legal landscape governing space exploration, mining and activities is largely defined by two international treaties, but their effectiveness, or lack thereof, in preventing exploitation and safeguarding resources is highly concerning. The 1967 Outer Space Treaty (OST), signed by a majority of countries, emphasizes the equitable exploration and use of outer space. However, its broad language and lack of specificity fail to address the intricacies of space colonization and mining, leaving room for potential exploitation and resource depletion. This led to the formation of a new treaty, the 1979 Moon Treaty, which aimed to rectify the shortcomings of the OST by specifically protecting celestial bodies from environmental disruption. However, as lawyer Brandon C. Gruner (2004, 329) writes, there is a view that agreeing to the Moon Treaty would result in a “transmission of wealth, political power, and technology from the space-faring nations to the Third World countries” due to equitable-sharing provisions outlined in the treaty. As such, its acceptance has been extremely limited, with most spacefaring nations yet to ratify it.<sup>2</sup>

In the absence of widespread adherence to these treaties, advocates for space colonization advocate for a cautious and deliberate approach driven by necessity (see, for example, Delgado-López 2015; Schwartz 2019; Slobodian 2015; Torres 2018; Traphagan 2019). Many argue for careful consideration of the ethical and environmental implications of venturing into space. Some

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2 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 5 December 1979, Res 34/68, 1363 UNTS 3 (entered into force 11 July 1984), online: <<https://treaties.unoda.org/t/moon>>.

have suggested creating designated zones using categories such as tourism, facilities, mining and protected park zones (McKay 2021; Cockell and Horneck 2006). But as pointed out by Alessandra Marino et al. (2023, 282), this approach mirrors settler-colonial “territorial ordering,” which, to date, “ha[s] not protected our planet from the consequences of anthropogenic activities” (38). It is essential to recognize that assuming space colonization is an inevitability disregards the concerns of the majority of Earth’s population. Rather than forging ahead with discussions solely driven by the interests of financial and political elites, an implementation of space law that foregrounds inclusivity, ethics and the reimagining of human activities must be prioritized.

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## Reimagining Space Activities

Indigenous communities are increasingly demonstrating their unique role in the space industry, enriching both technological innovation and ethical considerations. One case study is the Centre for Appropriate Technology in central Australia, where Indigenous values are integrated with space technology. The centre uses satellite imagery for disaster management specific to local demands and concerns, exemplifying how technology can be values-driven and prioritizing capability building and self-determination within Indigenous communities. This approach addresses local challenges and also paves the way for positive Indigenous participation in shaping the current and future use of space technologies.

Another example of Indigenous-led innovation is that imagined by Terri Janke and her co-authors under commission by the City of Parramatta in Sydney, Australia (Janke, Wilson and Langton-Batty 2020). The idea for the National First Peoples Science Centre comes from concerns about the increasing use of Indigenous knowledge and expressions of culture in modern scientific endeavours without proper engagement or acknowledgement. The authors outline that the centre would have six key functions: the development of a protocol, storing knowledge, building economic strategy, funding research,

offering consultation and advocacy of First Peoples science and protocol, and creating employment and training opportunities for Indigenous peoples. The centre is unconfirmed at this stage, but it outlines both the need for and the immense benefits of supporting Indigenous-led initiatives.

A common point of contention between industry and Indigenous communities is land use. An excellent example of successful land management is demonstrated by the Wajarri Yamatji people and the Australian Square Kilometre Array Pathfinder (ASKAP), which is managed by Australia’s scientific research body, the Commonwealth Scientific and Industrial Research Organisation. ASKAP is a radio telescope array located in western Australia, and its construction and operation involved close consultation and collaboration with the local Indigenous people to ensure cultural heritage, land use and Indigenous interests were respected and integrated into the project. Initiatives include cultural heritage management, employment and training, cultural awareness programs for the ASKAP staff and visitors and ongoing engagement programs with the local Indigenous people. Overall, the collaboration between the Wajarri Yamatji people and ASKAP serves as a model for how large-scale scientific projects can be conducted in a way that respects traditional landowners.

Indigenous expertise in sustainable land management will be vital for future off-Earth explorations. An example of such a collaboration exists at the Yawuru Nagulagun Marine Park in Western Australia. Situated in Australia’s Kimberley region, the Yawuru Nagulagun Marine Park has a unique governance structure, which integrates Indigenous customs, knowledge, land rights and practices into sustainable resource management. A central principle in the Yawuru Nagulagun governance structure is that of co-management, where traditional owners work alongside government agencies to monitor and protect the marine environment. This co-management approach ensures that Indigenous perspectives are central to decision-making processes. Additionally, the Yawuru Nagulagun Marine Park incorporates Indigenous cultural values into its management strategies by identifying and protecting sacred sites. The marine park serves as a living example of Indigenous ecological stewardship and a model for inclusive and sustainable co-management practices worldwide.

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## Objectives

Exploring historic and present-day Indigenous involvement in space exploration and the space industry reveals several emerging themes. Core tenets of effective collaboration include:

- **Caretaking:** Recognizing the importance of Indigenous-led astro-environmentalism and conservation efforts both on and off Earth. This involves preserving and protecting celestial environments and promoting sustainable practices informed by Indigenous knowledge and values.
- **Collaboration:** Facilitating respectful relationships between space agencies or research institutions and communities to enable co-creation and co-management, as well as to address environmental impacts and cultural heritage preservation. This collaboration also seeks to ensure the equitable distribution of benefits and opportunities arising from space activities.
- **Protocol:** Developing protocols for engaging Indigenous peoples and conducting space activities that align with Indigenous values and practices. These protocols should include principles of free, prior and informed consent, as well as mechanisms for fair benefit sharing and mutual agreement on terms and conditions.
- **Equal opportunity:** Providing Indigenous communities with opportunities to participate in, as well as learn and benefit from, space science, technology and related careers. This includes initiatives such as entrepreneurship, education, technology transfer, knowledge storage and management and job creation, thereby contributing to Indigenous economic growth and self-determination.
- **Indigenous narratives:** Promoting Indigenous knowledges, stories, values and cultural practices related to the cosmos. It is vital that this step implements ways to avoid the exploitation of Indigenous intellectual property (IP), including land and language.

In setting out these key objectives, it is crucial to recognize the diverse mechanisms and approaches that can be employed to achieve them. For instance, Indigenous-led conservation

efforts take various forms worldwide, including Indigenous protected and conserved areas, traditional land management practices and Indigenous ranger programs. These approaches prioritize community empowerment, cultural resilience and holistic environmental stewardship.

Collaboration with Indigenous communities should be guided by principles such as free, prior and informed consent and co-creation, as well as fostering meaningful partnerships grounded in mutual respect and shared values. Protocols for engagement could draw from existing frameworks such as the Nagoya Protocol, a global agreement on the ethics of biodiversity, as outlined in Janke, Wilson and Langton-Batty (2020, 10), which ensures fair benefit sharing and respect for Indigenous rights and knowledge.

Providing equal opportunities to Indigenous communities requires genuine engagement and consultation, avoiding token gestures or superficial consultations that may result in harm. As evidenced by the protests on Mauna Kea after the Thirty Meter Telescope conservationists failed to consult the local Indigenous population, and the backlash that the space company Rocket Lab has received for its lack of meaningful engagement with the local Indigenous peoples in New Zealand, genuine collaboration, engagement and benefit sharing with Indigenous communities benefits all. Ensuring equitable benefit sharing will largely depend on negotiation and the needs of all parties, and will require rigorous evaluation and monitoring programs to ensure assurances are met.

Last is the promotion, celebration and use of Indigenous IP. As explored in a *Nature* paper on the ethics of space exploration, such a collaboration could help achieve an “understanding [of] space and Earth as interconnected domains, mutually shaped by scientific theories and practices” (Marino et al. 2023, 1031). However, it is crucial that the recognition of Indigenous voices in space exploration extends beyond the naming of celestial objects, a trend that has become popular in recent decades. The increasing acknowledgement of the importance of Indigenous involvement in naming decisions signifies a crucial step toward honouring Indigenous sovereignty over their cultural heritage (ibid.). However, to truly integrate Indigenous knowledge, values and perspectives into the space industry, a comprehensive engagement and consultation process, largely outlined by the preceding objectives, is required.



Through these objectives and approaches, meaningful collaboration between Indigenous peoples and the space industry can be achieved.

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## Policy Recommendations

The following are recommendations to help ensure that successful collaboration between Indigenous peoples and the space industry can be achieved in the future:

- acknowledge and incorporate Indigenous knowledge and perspectives in space activities;
- learn from Indigenous practices, values and traditions;
- recognize Indigenous custodianship;
- embrace sustainable practices;
- safeguard significant places, including those in the sky and off-Earth;
- re-evaluate terminology, perspectives and the normalization of settler-colonial practices;
- prioritize collaborative land-use practices;
- foster interdisciplinary dialogues and respect;
- strengthen international cooperation;
- amend and update the 1967 OST;
- ratify the 1979 Moon Treaty or create state-based legislation;
- incorporate Indigenous expertise into astro-environmentalist discussions; and
- implement widespread Indigenous-led centres to help contribute to space-related activities and assist in the collaboration between Indigenous peoples, government and the private sector.

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## Conclusion

In conclusion, the exploration of historic and present-day Indigenous involvement in space exploration and the space industry underscores the vital importance of fostering meaningful collaboration guided by the core principles of caretaking, collaboration, protocol development, equal opportunity provision and promotion of Indigenous narratives. By prioritizing the preservation and protection of celestial environments, fostering respectful relationships, establishing protocols for engagement, providing equal opportunities and promoting Indigenous knowledges and values, the space industry can move toward a more inclusive, ethical and sustainable future. Through genuine engagement, consultation and mutual respect, Indigenous communities can contribute their invaluable perspectives, knowledge and practices to enrich space activities, while also benefiting from the resulting economic growth, self-determination and cultural preservation. By embracing Indigenous-led initiatives and prioritizing inclusivity, the space industry can forge meaningful partnerships that honour Indigenous sovereignty, promote environmental stewardship and advance humanity's collective presence in the cosmos.



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