

Creating a Culture of Extraterrestrial Environmental Concern

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ABSTRACT: We will regret our actions on the Moon and Mars if we do not assess their environmental impacts and institute measures to avoid them. Such assessments are routine on Earth, and when made part of planning they are effective in reducing adverse impacts, cutting costs by identifying problems before they arise, and supporting resource sustainability. Without establishing a similar culture of environmental concern in space, we should expect environmental damage and the associated costs of remediation. This chapter cites actions on Earth that have resulted in adverse environmental consequences, describes how our relationships with space are dominated by Western cultures of aggressive landscape domination, provides suggestions on how to avoid repeating past mistakes, and calls for including non-Western perspectives in the discussion. If a culture of environmental awareness is nurtured among space actors, a habit of practices of concern will create options for more enlightened, commercially sustainable, and socially productive futures as we venture into this new commons.

KEY WORDS: Extraterrestrial environmental assessment; Indigenous cosmologies; outer space resource sustainability; space mining

1. Repeating past mistakes

A critical piece is missing from the puzzle of outer space exploration and exploitation, yet its absence has not been recognized by those leading government and commercial space actions. Without it, we will miss opportunities to increase the efficiency of space ventures and sustain

resources and will diminish options for future uses for decades or centuries. We will duplicate the same costly but avoidable mistakes made on Earth. We need to make a commitment to consider ways to minimize the foreseeable adverse effects of our actions on the extraterrestrial environments we will alter. Without awareness and precaution, our actions will result in a range of irreparable environmental damage that will affect future science, human habitation, commercial enterprise, and other futures. The issue was a foreseeable problem as early as 1986 when space ethicist Eugene Hargrove warned that space exploration “remains steadfastly focused on earthbound environmental issues” (1986, p. ix). Yet even now, well into the 21st century, most have not recognized this need. If we begin to significantly affect those extraterrestrial areas without environmental precautions, future government and private industrial/commercial projects “may simply produce a new environmental crisis that dwarfs our current one (on Earth)” (p. ix-x). Such outcomes are, however, avoidable. We have and use the analytical tools and procedures for achieving more favorable outcomes on Earth. We need to apply them to space.

Impact assessments required prior to undertaking major construction projects have proven to be effective in decreasing the costs of environmental damages (e.g., the costs of remediation, wasted resources, and other detriments) by creating efficiencies and supporting resource sustainability. In the US, the National Environmental Policy Act of 1970¹ (NEPA) was enacted specifically to:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

- Attain the widest range of beneficial uses of the environment without degradation or unintended consequences; and
- Preserve important historic, cultural, and natural sites.

Should we not seek the same goals in space? Absolutely! But there are essentially no requirements for impact analyses for actions outside low Earth orbits (LEO) in the US, Europe, or other spacefaring nations except for Belgium and France (Mustow 2018)ⁱⁱ. Article 7 of the Moon Agreementⁱⁱⁱ (1979) states that nations shall take measures to not cause adverse changes to bodies in our Solar System or disrupt the balance of their environments, but among space-faring nations, only France and India have signed the document. In the US, for example, the federal agency responsible for administering NEPA has determined that although the act allows impact analysis for US actions in space, it will not be required for actions beyond LEO (Boling 2019). The policy demonstrates the political resolve to not impede space activities with regulations that may stifle near-term growth. But ignoring environmental impacts has proven to be short-sighted; it does not support longer-term, sustainable development and can lead to environmental disasters and significant social and other costs. There is no reason to expect different results in space. We will establish a precedent of disregard that will continue as we expand beyond Mars. It will encourage a pattern of destruction rather than enlightened creation (Kramer 2014).

2. Western roots of environmental estrangement

An increasingly technological and industrial world that demands continued economic growth has altered Western cultures' relationships with the environment (Tarnas 1991, p. 362-3). Both renewable and non-renewable resources have often been overutilized to secure quick profits with a minimum of consideration for their environmental impacts. A few examples include mining,

deep wells that draw down millennia-old aquifers, and reliance on fossil fuels. All have contributed to maintaining Western economic, political, and cultural facets of society that demand growth. Frederick Turner, American historian and biographer, captured these relationships with the environment when he describes that “a feeling of American loneliness began to insist upon itself, a crucial, profound estrangement of the inhabitants from their habitat: a rootless, restless people with a culture of superhighways precluding rest and a furious penchant for tearing up last year’s improvements in a ceaseless search for some gaudy ultimate.” He continues, “This is an extraordinary phenomenon, and indications of it are to be found earlier than the political origins of the Republic” (1992, p. 5). Much earlier. He traces its roots to Old Testament periods where nature, in Abrahamic cultures, exercised “a cruel power over these wanderers, and they sought emancipation from it....They sought to suppress the world of nature” (p. 44). The gods ceased to be of the Earth, the palpable world we saw and touched, and were placed in the supernatural heavens. Perhaps this was where the Earth was first considered the “other,” a force and personality independent of humans and a threat to be fought and defeated.

Aided by technology over the past 500 years, Western expansionism and exceptionalism has allowed increasing access to the globe’s resources. Waves of European colonization encouraged acquiring lands cheaply, often without the free consent of Indigenous populations, opening areas to exploitation with no penalty for long-term environmental damages done (Diamond 1999; Mann 2011). Lands were put to their “highest and best use,” where resources were considered worthless unless they created wealth. Valuation of landscapes failed to consider their other attributes, such as their role in resource renewal, water quality and quantity, climate moderation, and, importantly, their spiritual meaning. Conveniently, those privileged by policies of resource

extraction purely for capital gain were those who defined “highest and best” and determined what was “unproductive.”^{iv} The physical and spiritual relationships of Indigenous peoples to the land and its resources were largely ignored. This model for accumulation of wealth from the land through ever-increasing production is basic to both capitalism and communism (with its communal rather than private ownership); the environmental consequences are the same. Regulations that might reduce profits or slow production, such as analyses of environmental impacts, are avoided unless overwhelming political or social pressures demand them.

During the second half of the 20th century, the US public became more aware of the relationship between the environment and their quality of life. Oil spills, pesticide-related wildlife die-offs, environmental contaminants, the persistence of pathogenic industrial compounds, declining water quality, and other problems were frequently publicized. Simultaneously, evidence demonstrated that a continued growth model of development that ignored consideration of environmental effects was unsustainable.

Many industries that profited from a lack of regulation argued that the science did not support opponents’ claims, that there was little proof that their actions had adverse impacts. Pesticide manufacturers reacted strongly against Rachel Carson’s “*Silent Spring*” (1962), an analysis of pesticides’ effects on non-target species, including humans. Her data and conclusions were challenged. An executive of the American Cyanamid Company, a major manufacturer of the agricultural chemicals cited by Carson as harming the environment, stated, “If man were to faithfully follow the teachings of Miss Carson we would return to the Dark Ages” (Weis 2014, p. 11). Carson was vindicated, however, as her analyses were proven valid, and all phases of the

industry have since been regulated. With tobacco, research demonstrated a link between smoking and cancer as early as the 1950s. Again, industries challenged scientific findings and claimed their products to be (nearly) harmless. They employed tactics to resist regulation including public relations campaigns, buying scientific and other expertise to create controversy about established facts, funding political parties, hiring lobbyists to influence policy, using front groups and allied industries to oppose tobacco control measures, and corrupting public officials (Saloojee and Dagli 2000, p. 902). We are now witnessing a third, potentially devastating example of industries' reluctance to be regulated regarding the environment -- global climate change. Although evidence of the relationship between greenhouse gases produced through human activities and climate is overwhelming, many in governments and affected industries still use the same tactics to stall regulation that were employed by the tobacco industry (Dunlap and McCright 2010).

Similar patterns are now emerging regarding impacts to extraterrestrial environments, but many government, private industry, and science-oriented space actors maintain their future actions will not harm extraterrestrial landscapes. Consider artists' depictions of human use of lunar or Martian landscapes. Nearly all (save dystopian science fiction imaginings) avoid images challenging a singular vision that human uses will have only benign impacts – no landfills or heaps of mining tailings; no evidence of subsurface ice polluted by what may drip from machinery or be dumped to cheaply dispose of chemical waste. We are to believe the space miner or builder is immune from error, poor judgment, or accident, and that by not considering environmental impacts, they will not materialize. Our experiences on Earth have proven that is a costly assumption.

Why should we expect better on the Moon or Mars than what we witness on Earth daily? Where is the incentive for better environmental behavior in extraterrestrial environments? Perhaps it is easier to focus on dreams of space exploration unencumbered by the reality of our potential to adversely affect those landscapes. That vision certainly supports the continued growth model, the Western pattern of landscape domination, and a denial (or ignorance) of the potential for environmental damage. How such relationships are evolving in space is evidenced in the colonizing language we frequently hear when space is defined as an adversary that must be fought, conquered, tamed, and “civilized” (Kramer 2014, Billings 1997). It creates the dichotomy of we and them, the terrestrial and the extraterrestrial. Such an approach to space creates not only a rationale for not regarding outer space landscapes as worthy of conserving, but an obligation to dominate and pillage them.

Rachel Carson quotes essayist E.B. White in the introduction to “*Silent Spring*”: “Our approach to nature is to beat it into submission. We would stand a better chance of survival if we accommodated ourselves to this planet and viewed it appreciatively instead of skeptically and dictatorially” (1962). While White is decidedly referencing the Earth, it is applicable to space. We have established an adversarial relationship with the Moon and, especially, Mars. By characterizing other worlds as a threat, we are justified, as he observes, to beat it into submission. The National Geographic Society’s television miniseries *Mars* (2016) blended a fictional story of the founding of a Mars settlement with interviews and commentary from actual scientists and others prominent in governance and commercial enterprises. One of the fictional characters, Hana Seung, refers to Mars as a “vicious planet” and that “Mars would kill us in any of a

thousand ways.” Immediately afterwards, Casey E. Dreier, the hardly fictional Director of Space Policy of the Planetary Society, states, “Mars itself is your enemy. You have a shared common enemy of Mars trying to kill you every day.” Giving Mars such a malicious and menacing personality not only allows decimation of its landscape but imposes a duty to subdue it, to despoil it. This language abets colonizers’ claims to property and diminishes care for long-term environmental consequences. A different approach is needed as we voyage into space, and non-Western traditions offer much to consider.

3. Ruling authorities and Indigenous perspectives

The Outer Space Treaty^v (1967) is clear in Article I in asserting that “the exploration and use of outer space...shall be carried out for the benefit and in the interests of all countries...and shall be the province of all mankind.” Similarly, Article 4 of the Moon Agreement reiterated the standard in stating, “the exploration and use of the Moon shall be the province of all mankind.” Their intent is clear: all should benefit from outer space exploration and exploitation. It follows that to achieve the documents’ objectives, all must participate in describing desired outcomes. This would include representation of the world’s philosophies, cultures, and traditions, not just the Western, frequently colonial, perspectives that have been dominant from initial research on rocketry to the emergence of “new space.”^{vi} In a critique of the assumption of “the Colonial Mindset” of the West, Danielle Wood, Massachusetts Institute of Technology professor and specialist in societal development, writes, “whoever has the technology, economic means, and the will to do so, has the right to claim property, territory, and resources, regardless of...claims of other people and the claims of environment...This Colonial Mindset is already built into the fabric of thought as space agencies, engineers, scientists, entrepreneurs and explorers

contemplate future human activity on the Moon, Asteroids, Mars, and beyond” (2020). While there are certainly many advantages of Western capitalism in elevating the human condition, when applied to space, extraterrestrial environments are being commodified to be exploited for continued growth at the expense of sustainability, landscape, and should endemic life be present, ecological balance (Shammas and Holen 2019). Unfortunately, environmental sustainability has been provided little status in current visions of extraterrestrial development; sustainability of profits is paramount.

Indigenous cultures’ spiritual and philosophical relationships with landscapes are certainly not uniform, and the generalities expressed here make no claim to be universals. Their cosmologies are as varied as the cultures themselves (Monani and Adamson 2016). But while non-Western voices are excluded from conversations on the futures of space, they must be considered in building policies affecting extraterrestrial environments if we wish to balance the prevalent pretensions to objectivity of the Western view of science and the cosmos with Indigenous perspectives, which are often dismissed as quaint and of no relevance (Asselin 2015; Baird 2012). As expressed by Shammas and Holen, “there is an expedient conflation of capitalist interests with a universalizing notion of the interests of humanity” (2019, p. 3). Exclusion, or worse, pandering by reference to Indigenous thought in dialogues citing outer space “for all mankind” without including them in decision-making, is hypocritical.

Some Indigenous cultures have traditions of viewing landscapes and humans as a cooperative whole, a relationship where the line distinguishing human and landscape is blurred. They tend to be more holistic as opposed to the West’s predominantly mechanistic and materialistic

associations with the land and its characteristics. As such, Indigenous thought may contribute to greater respect for and a wiser use of space environments. They may be crucial in structuring a sustainable relationship with extraterrestrial landscapes in that they often offer “alternative ways of seeing ourselves in relationship to the natural world” (Young 1987, p. 270). Rather than having an adversarial relationship with the environment, many non-Western traditions seek to deepen a cooperative spirit with landscapes by recognizing that humans are an intrinsic part of that environment; quite literally, “we are the land, and the land is us” (Korff 2016). Such a bond is not only with plants and animals, but can extend to the inanimate, such as mountains, the sky, stones, water, and even celestial bodies (Hollabaugh 2017; Capper 2020). In Australia, Ambelin Kwaymullina, an Aboriginal woman, explains, “For Aboriginal peoples, country is much more than a place. Rock, tree, river, hill, animal, human – all were formed of the same substance by the Ancestors who continue to live in land, water, sky. Country is filled with relations speaking language and following Law, no matter whether the shape of that relation is human, rock, crow, wattle. Country is loved, needed, and cared for, and country loves, needs, and cares for her peoples in turn. Country is family, culture, identity. Country is self” (Korff 2016). In North America, many Indigenous peoples developed strong identities with celestial objects. The Skidi Pawnee’s world, for example, centers on the stars and the interaction of the Earth and the cosmos. “The role of astronomy is extensive, for it appears as an organizing principle for all other aspects of Skidi life – political hierarchy, village layout, agricultural practices, socioreligious activities, and the embellishment of material culture. (All combine to form) a complex star theology” (Chamberlain 1982, p. 207). None of this infers that Indigenous humans do not alter landscapes to sustain their health, welfare, and longevity as a society (Mann 2005;

Crosby 2004). Some routinely burn prairies to encourage the species they hunt or divert water for agriculture (Abrams 2020). But those actions shape landscapes; they don't destroy them.

In Hawaii, Indigenous traditions of creation hold the mountain Maunakea to be an ancestor, sharing genealogical ties with Kanaka Maoli, native Hawaiians. It is a sacred part of the landscape. As such, they are protesting the installation of a 30-meter telescope on its summit. A spokesperson for the group explained, "We have always revered Maunakea as our sacred mauna. In fact, it is part of our cosmology, the very beginning of Earth from which man descends, so for us it's a very spiritual matter" (Bartels 2020). In New Zealand, Māori activism resulted in granting the Whanganui River legal personhood status. In North America, many features of the landscape have spiritual status that deeply affect their native cultures and traditions (Berman 2012). And, as Daniel Capper, Professor of Philosophy and Religion at the University of Southern Mississippi, cites in his chapter of this book, Buddhist traditions include inanimate (from a Western perspective) objects such as mountains as an intrinsic part not only of the landscape but as instructive for us all.

These few examples speak to an Indigenous sense of place not generally found in Western approaches to landscape. If our moon and Mars are considered as non-places without spiritual meaning and as enemies to be conquered without consideration of what is described by Brad Tabas (Professor of Space Humanities at the École Nationale Supérieure de Techniques Avancées Bretagne) as "human entanglement," they remain environmentally at risk, not worthy of even an afterthought (2021; Mitchell et al. 2020).

4. A pathway to a solution

Two options would help in averting environmental failures in space. The first, national or international legal regulation through “hard law” (similar to NEPA), would clarify space actors’ responsibilities (Kramer 2014; Mustow 2018). However, enacting laws or treaties seems remote given political inertia and current competition to advance space enterprises. A second option is for space industries themselves to create, administer, and enforce industrial standards, practices, codes of conduct, and protocols for identifying and reducing adverse environmental impacts. Such self-regulation has been practiced for centuries by artisanal and other groups, such as trade guilds and manufacturing associations. This could be implemented quickly, would be responsive to industries’ needs, and could be modified to adapt to the new challenges of working in space without the need for a lengthy legislative process (Kramer 2017). While I believe it in space industries’ best interest to be proactive, this option, too, seems unlikely given industries’ past record of resistance to environmental regulation. Action might be taken only after there is wide recognition of the issue and a demand for an effective response, and that may occur only after an extraterrestrial environmental disaster or after significant profits are made from space resources. Should large profits be made at the expense of alien environments, there may be a call from “all humankind” both for sharing the wealth and caring for those environments. However, as with the environmental issues precipitated by European colonization, it may take decades for extraterrestrial damages to trigger regulations that slow, if not stop, that harm. And as we have witnessed on Earth, many of those harms will be irreversible.

Although some Indigenous voices have been invited to participate in space policy discussions, it is debatable whether the results of those dialogues have influenced capitalist approaches to space

exploration and exploitation. There are programs that extend space “science” to Indigenous peoples as part of overall outreach programs, such as STEM (science, technology, engineering, and mathematics) education, but has the reciprocal education of Westerners in Indigenous ways of thinking, especially regarding relationships with landscapes, happened? If so, were responses taken seriously in the formulation of policy? It is foreseeable that Indigenous groups may need to demand consideration of the fate of extraterrestrial environments, whether through hard law, international treaties, industrial standards, or some other protocol. Representatives of those groups should strongly consider organizing a united effort to make their perspectives heard, recognizing that the extraterrestrial environment is our shared environment, that as we are a part of Earth’s landscapes, we are also part of the landscapes of the Moon and Mars and the universe. Non-Western perspectives may be our best hope for achieving those goals.

5. Summary

To summarize, I would like to highlight four conclusions presented in this chapter. First, extraterrestrial actions will result in adverse environmental impacts that may reduce options for future generations’ use of those landscapes, decrease sustainability of resources, increase costs of development, and cause human health problems and other negative outcomes. Second, we have the tools to assess environmental impacts and mitigate or avoid harms. Third, space-faring governments and commercial ventures have avoided discussions of extraterrestrial environmental impact assessment, perhaps believing that knowledge of potential environmental harms may stifle commercial development. This is short-sighted and counterproductive to sustainable use. And finally, Western philosophies regarding landscapes tend to be adversarial – “man against nature.” Many Indigenous traditions view humans as an integral part of the

landscape, a coexistence that is not only mutually favorable but essential to their physical and spiritual existence. These perspectives need to be heard to promote the wise use of space in keeping with the sentiments of the Outer Space Treaty, Moon Agreement, and similar documents.

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ⁱNEPA describes national policy to create conditions under which man and nature can exist in productive harmony, for present and future generations. It directs the preparation of environmental assessments.

ⁱⁱ Belgium's Law on the Activities of Launching, Flight Operation or Guidance of Space Objects of 2013 requires consideration of the impact on both the Earth and any celestial body affected. The French Space Operations Act includes requirements for those proposing actions to list measures to avoid, reduce, or mitigate the adverse effects on Earth and outer space.

ⁱⁱⁱ Agreement Governing the Activities of States on the Moon and Other Celestial Bodies. While specifically naming the Moon, the Agreement applies to all celestial bodies in our Solar System other than the Earth. 18 Parties have ratified the Agreement, 4 have signed (including France and India). Source:
https://www.unoosa.org/res/oosadoc/data/documents/2021/aac_105c_22021crp/aac_105c_22021crp_10_0_html/AC105_C2_2021_CRP10E.pdf.

^{iv} In the case of the former Belgian Congo, the entire country was "owned" by one individual, King Leopold, including its lands, resources, and peoples.

^v Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

^{vi} New space refers to the recent growth of private commercial space ventures such as SpaceX, Blue Origin, and others that have replaced predominantly scientific and political space activities with commercial and other economic purposes.