

## **Issue Brief: Space Settlement and Resource Extraction**

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For many centuries, powerful countries have obtained control over land and its native people to establish their dominance on the world stage. The term “colonization” has been used to describe this action of settlement and development of inhabited territories, which is now being discussed with regards to other planets [1]. To better understand space settlement, it is helpful to look at an example of colonization that took place on Earth, such as that of North America by Europeans starting in the 15th century, during which thousands of Native American communities were displaced and destroyed. Although this settlement was at the expense of a well-established population of Indigenous peoples, this allowed the United States to rapidly develop and expand as a nation. It is clear that these Indigenous communities are still affected by European colonization, as it forced changes to the role and importance of Indigenous peoples in America while the country continued to expand upon and utilize Native American lands [2].

Settlement of other planets has long been a dream of our species ever since we could identify other celestial bodies in the sky. The excitement of the Apollo moon landing led to dreams of a human mission to Mars and future space habitats by the end of the 20th century [3,4]. While national interest turned away from this goal to face the many challenges that occurred in the last half of the 20th century, the recent rise of the commercial space industry has once again fueled a discussion about settling of other planets in our solar system and beyond. For example, Elon Musk has repeatedly discussed his desire that SpaceX will settle and terraform Mars, with the hope that the planet will one day become a self sufficient entity separate from Earth [5].

Dr. Robert Zubrin, founder of the Mars Society and author of *The Case for Mars*, has also long supported plans to settle Mars. One of Zubrin’s ideas to encourage settlement in a future Martian city is to employ indentured servitude, like that used by the British to encourage settlement on the North American continent in the early US colonies. Zubrin and Musk hypothesize selling one way tickets to Mars costing \$200,000 a ticket to roughly 1 million people [5]. The Martian settlers would sell their labor for seven years to pay off a ticket. When asked if this would open the Martian colonies to exploitation, Zubrin replied “Well sure, that's what people do to each other all the time" [5]. A Martian settlement would bring a number of benefits. Humans would live on another planet, ensuring that if another extinction-level event occurred--such as an asteroid impact, a nuclear winter, a viral pandemic, or severe climate change--our species would have another chance at life. Technological advancements achieved on Mars would be able to improve the life of humans on both planets; for example, a successful technology for growing plants on Mars could also help feed many people here on Earth.

Settling of the Moon is also in the works, with NASA planning to establish a base in lunar orbit with the aim of mining the lunar surface for water ice for use as oxygen, potable water, and rocket fuel [6]. Establishing a base in lunar orbit facilitates both continuous

exploration of the Moon and deep space exploration, as the water ice can be utilized for rocket fuel and the lower gravity makes it easier to reach destinations within and beyond the solar system. Some speculate that the Moon could eventually supply Helium-3—an isotope deposited on its surface by solar winds—as an effective fuel for fusion reactors back on an energy-hungry Earth [6].

However, the mining industry on Earth has come under criticism for their environmentally hazardous processes. Rare mineral mines in China have caused severe damage to surface vegetation, caused soil erosion, pollution and acidification, and even eliminated food crop output [7]. While these issues may not seem to matter for “lifeless” asteroids, rushing in to mine them could prevent the opportunity to study the origin of the asteroid for new information, and cause damage to a body we do not fully understand, irreparably damaging it. Additionally, the mining industry has engaged in the exploitation of labour to mine precious metals on Earth. Children as young as 7 have been known to toil in rare mineral mines at gunpoint in the Congo [8]. Without resource regulation in place, space resource companies would be free to continue these practices. While the Outer Space Treaty of 1967 outlines that “outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”, it does allow for drilling. Similar to fishers who don’t own the oceans but have a right to put nets into the water and own any fish they bring on deck, space mining companies would own any drilled material and can sell the resources at profit [9]. These profits will go to large corporations, and as no country would have jurisdiction over mining operations on the Moon or on any asteroid, there would be no way for any government to tax the profits, ensuring little, if any, financial benefit to citizens [10]. Currently, several space mining companies have attempted to amass the capital to invest in asteroid mining. However these companies faced costs too great with no customer base for the next 12-15 years, and were acquired by other tech companies with no interest in space mining [11].

Beyond the Moon and asteroids, other “lifeless” bodies like Mars may not be as lifeless as previously imagined. An important concern is that of biospheres—the regions of the surface, atmosphere, and hydrosphere of planets—and whether they have a right to exist as they are now. This includes the question of whether a biosphere should be protected in the event it could develop into a potentially habitable body for humans or other life forms [9]. As potential life may exist in forms we do not understand, it is important to consider whether other planets have rights to their own evolutionary track. By altering another microbiome, we are furthering the existence of humankind, but this may alter the existing evolutionary progress of other species we are unaware of [12]. While the mere presence of organisms from Earth on another planet may alter its biosphere, another cause of alteration may be a more deliberate act such as terraforming. Most commonly associated with Mars, terraforming is the act of altering a planet’s environment so that it can support life in ways similar to Earth. This involves changing the amount of pressure and gaseous elements within the atmosphere, completely altering the composition of the planet, and what life it can support [13].

Due to the risks associated with settling on planets like Mars, planetary protection policy has arisen as a way to regulate stakeholders who hope to benefit from space settlement [12]. NASA's Planetary Protection Subcommittee created the COSPAR Policy and Guidelines for Human Missions in 2002, which was last amended in 2011. This policy is clear in stating that backwards contamination on Earth is the "highest planetary protection priority in Mars exploration" [14]. Many of the guidelines for robotic and crewed missions to Mars do not emphasize the importance of protecting microbial life, or create concrete evaluation of the adherence of individuals and organizations to these guidelines [12,14]. Therefore, the question arises of whether new policies should be developed to encompass risks with planetary settlement and increase enforcement of those policies [12].

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Stakeholders:

1. Commercial Companies
2. Rare Minerals Mining Companies
3. Venture Capitalists
4. Governments
5. Citizens
6. Scientists

Questions:

- ‘Do we have an ethical obligation to preserve a planetary environment to the same degree that we seek to protect our Earth’s environment?’
- Does this obligation hold, even if there is no life on a planet?
- Or, since environmental ethics seek to benefit and enhance life, do we have an obligation to see that terrestrial life expands onto lifeless planets?
- Does the type of extraterrestrial life we discover determine the appropriate level of protection? In other words, are exotic microbes deserving of the same level of protection as intelligent life?’
- How does the media influence public opinion on what happens in outer space?
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