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A CRITICAL REVIEW OF PLANETARY PROTECTION STRATEGY

Abstract

Planetary protection policies, such as those codified and promulgated by the Committee on Space Research (COSPAR) and the Outer Space Treaty, are inherently tied to the idea of preventing “harmful” contamination and limiting the transfer of biological material from the Earth to other celestial bodies and vice versa. The interpretation of what might constitute “harmful contamination”, however, is far from self-evident and is dependent on how one defines the delineation between living/biotic and non-living/abiotic entities and on the perceived significance of preventing contamination of a particular environment.

At present, there is a limited amount of data with which to inform planetary protection policy: the only data available on biological life is from Earth-based lifeforms, and scientific understanding of biological survivability in non-Earth contexts is incomplete at best. Experiments such as those demonstrating the survivability of terrestrial microbes in microgravity and high-radiation environments, as well as recent advances in documenting extremophilic microbiota, have challenged prior assumptions on the limits of habitability and biological diversity, which would suggest that it would be beneficial for planetary protection policies to err on the side of more stringent protections. The present planetary protection approach exemplified by COSPAR policy, however, errs on the side of minimalism, and uses the standard of whether canonical Earth-based lifeforms have been observed to survive in similar environments as its standard for determining contamination risk. Human interests and the desire to minimize the burden of planetary protection compliance are also prioritized above preserving the integrity of planetary environments: indeed, current planetary protection requirements do not mandate any sort of precautionary protections for planetary environments which are deemed not to be of direct scientific value.

This paper presents a critical evaluation of current planetary protection policy/strategy and the scientific assumptions that underpin it, and seeks to assess whether current strategy affords comprehensive protection to biological entities that would be classified as living under some of the main emerging definitions of life being discussed in the astrobiological literature. In particular, shortcomings of the current COSPAR risk classification system in accurately capturing risks to scientific interests, as well as in current measures taken to protect various planetary targets, are addressed based on the astrobiological literature. The paper also presents a recommended set of modifications to planetary protection strategy to better align with emerging perspectives on astrobiological life and biological survivability limits.