

BEYOND THE TARDIGRADES AFFAIR: PLANETARY
PROTECTION, COSPAR, AND THE FUTURE OF
PRIVATE SPACE REGULATION

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I.	INTRODUCTION	872
II.	COSPAR AT A GLANCE	881
	A. <i>The Organization of COSPAR</i>	881
	B. <i>COSPAR’s Panel on Planetary Protection</i>	882
	C. <i>COSPAR’S Planetary Protection Policy</i>	884
III.	CAN COSPAR BEAR THE WEIGHT OF BEING A STANDARD-SETTING BODY IN THE AGE OF PRIVATE SPACE EXPLORATION?	886
	A. <i>International Compliance with COSPAR Guidelines</i>	886
	1. <i>Compliance for Government-Sponsored Space Missions</i>	886
	2. <i>Compliance for Private Sector Space Missions</i>	889
	B. <i>Problems with COSPAR</i>	891
	1. <i>Institutional Design</i>	891
	2. <i>Lack of Participation in Decision-Making</i>	894
	3. <i>Unnecessarily Restrictive Guidelines</i>	895
	4. <i>No Mechanism for Monitoring Compliance</i>	896
	C. <i>Comparison to Other International Standards</i>	897
	1. <i>ICAO SARPS</i>	897
	2. <i>Codex Alimentarius</i>	900
	3. <i>Space Debris Mitigation Guidelines</i>	902

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IV. SHOULD WE RELY ON COSPAR TO SET PLANETARY PROTECTION STANDARDS FOR PRIVATE SPACE EXPLORATION?	905
A. <i>COSPAR is a Scientific Body</i>	906
B. <i>International Standards are Necessary for International Problems</i>	907
V. HOW CAN COSPAR ENCOURAGE PLANETARY PROTECTION COMPLIANCE AMONG PRIVATE SPACE ACTORS?	909
A. <i>Legalize the Policy in an International Instrument</i>	910
B. <i>Expand the Panel on Planetary Protection's Role in Monitoring Compliance</i>	912
C. <i>Incorporate the Policy in Private Sector Space Contracts</i>	914
VI. CONCLUSION	916

In April 2019, privately-funded Israeli lunar lander Beresheet crash-landed on the surface of the Moon, carrying thousands of microscopic animals called "tardigrades" that had been secretly added to its payload. This event is concerning to the international spacefaring community for two reasons. First, it implicates the law of planetary protection, which prevents Earth-origin biological materials from contaminating fragile extraterrestrial environments. Second, it highlights the need for tighter regulation over commercial activities in space, as more private companies enter the space sector seeking to profit from valuable resource exploitation, scientific discoveries, and the search for potentially habitable worlds.

This note takes a closer look at the Committee on Space Research (COSPAR), the international scientific organization responsible for promulgating non-legally binding planetary protection guidelines. While the COSPAR guidelines have been widely adopted by national space agencies, it remains unclear how they are imposed on the private sector. In turn, this note examines (1) whether COSPAR's institutional structure currently equips it to regulate the private sector, (2) whether the COSPAR planetary protection policy should be applied to the private sector, or if such policies are better off originating from national legislatures, and (3) how the COSPAR policy can be adapted and utilized for private sector planetary protection regulation. Ultimately, this note determines that while certain changes are necessary, relying on an international standard-setting body such as COSPAR is the best way to prevent future incidents like "The Tardigrades Affair" and ensure outer space is preserved and protected for generations to come.

I. INTRODUCTION

On April 11, 2019, nonprofit organization SpaceIL's *Beresheet*, a joint public-private lunar lander and probe, crash-

landed on the surface of the Moon.¹ A successful landing would have been historic in many respects—for Israel, as the nation’s first lunar mission,² and for the wider NewSpace community,³ as a chance to witness the first privately-launched moon landing and the advent of a new age of commercial space exploration.⁴ While the mission failed in these pursuits, it remained in the public spotlight months later due to concerns raised by *Beresheet’s* secret stowaways—tiny, eight-legged micro-animals known as “water bears,” “moss piglets,” or, chiefly, tardigrades.⁵

The tardigrades were a last-minute addition to a payload on the *Beresheet* lander, sponsored by the Arch Mission Foundation, a nonprofit organization based in Los Angeles whose

1. See Christopher D. Johnson et al., *The Curious Case of the Transgressing Tardigrades (Part 1)*, SPACE REV. (Aug. 26, 2019), <https://www.thespacereview.com/article/3783/1> (discussing the background of the *Beresheet* mission).

2. *SpaceIL, IAI to Send Time Capsule on Israel’s Historic Moon Mission*, SPACEIL (Dec. 17, 2018), <https://www.iai.co.il/spaceil-iai-send-time-capsule-israels-historic-moon-mission>.

3. “NewSpace” refers to the expansion of private industry in outer space. See Victor L. Shammass & Tomas B. Holen, *One Giant Leap for Capitalistkind: Private Enterprise in Outer Space*, 5 PALGRAVE COMMS. 1, 1–9 (2019) (noting the distinction between “‘Old Space’, a Cold War-era mode of space relations[,]” and “New Space” driven by private companies).

4. SpaceIL was competing in the Google Lunar X Prize (GLXP) contest to land the first privately-funded spacecraft on the Moon. Nathan Jeffay, *One Giant Step for Israel as Company Plots Moon Launch*, FORWARD (Apr. 30, 2013), <https://forward.com/news/israel/175464/one-giant-step-for-israel-as-company-plots-moon-la/?p=all>. While no company successfully completed the task by the contest’s deadline of March 31, 2018, the X Prize Foundation announced shortly after this date’s expiration that the contest would continue without a cash prize sponsored by Google. See Alessandra Potenza, *X Prize Relaunches its Moon Competition, but Without a Cash Prize*, VERGE (Apr. 5, 2018), <https://www.theverge.com/2018/4/5/17201902/lunar-xprize-re-launch-google-private-moon-missions> (reporting the competition ended without a winner). Despite *Beresheet’s* failed landing, the X Prize Foundation still awarded SpaceIL a \$1 million “Moonshot Award” for successfully touching the surface of the moon. Eytan Halon, *Despite Crash, SpaceIL to Receive \$1 Million Moonshot Award*, JERUSALEM POST (Apr. 13, 2019), <https://www.jpost.com/Jpost-Tech/Despite-crash-SpaceIL-to-receive-1-million-Moonshot-Award-586644>.

5. Zena Jensvold, *A New Shape-Shifting Species of Tardigrade with Spiky Eggs Stumps Scientists*, MASSIVE SCI. (Aug. 19, 2020), <https://massivesci.com/notes/tardigrades-antarctica-eggs-epigenetics/>.

goal is to create “a backup of planet Earth.”⁶ A few thousand dehydrated tardigrades, along with some samples of human DNA, were included in the Arch Mission Foundation’s lunar library. The tardigrades were tucked into a small object made of thin layers of nickel, which was loaded with images of classic books, language primers, and nearly all of the English Wikipedia.⁷ Importantly, however, the Arch Mission Foundation did not tell SpaceIL or other mission partners of its decision to include biological materials in *Beresheet*’s lunar library prior to launch.⁸ Had SpaceIL been aware of the tardigrades’ presence, U.S. law likely would have required the company to inform the Federal Aviation Administration (FAA) during the payload review process.⁹ The FAA had the authority to conduct this review because *Beresheet* was being launched from U.S. soil on a rocket owned by the American company

6. Daniel Oberhaus, *A Crashed Israeli Lunar Lander Spilled Tardigrades on the Moon*, WIRED (Aug. 5, 2019), <https://www.wired.com/story/a-crashed-israeli-lunar-lander-spilled-tardigrades-on-the-moon/>.

7. *Id.*

8. Johnson, *supra* note 1. The Arch Mission Foundation revealed this information in August, six months after launch and four months after the craft’s crash landing. Nova Spivack, Founder and Executive Director of Arch Mission Foundation, has noted that the decision to withhold this information was deliberate. See Chris Taylor, “*I’m the First Space Pirate!*” *How Tardigrades were Secretly Smuggled to the Moon*, MASHABLE (Aug. 8, 2019), <https://mashable.com/article/smuggled-moon-tardigrade/> (“We didn’t tell them we were putting life in this thing,” [Spivack] says. “Space agencies don’t like last-minute changes. So we just decided to take the risk . . .”).

9. See 14 CFR § 415.59 (2019) (“(a) A person requesting review of a particular payload or payload class shall identify the following: (1) Payload name; (2) Payload class; (3) Physical dimensions and weight of the payload; (4) Payload owner and operator, if different from the person requesting payload review; (5) Orbital parameters for parking, transfer and final orbits; (6) Hazardous materials . . . and radioactive materials, and the amounts of each; (7) Intended payload operations during the life of the payload; and (8) Delivery point in flight at which the payload will no longer be under the licensee’s control.”). The tardigrades could have been considered “hazardous material.” “In general, space law aside, the payload review process and the launch license application require a person to provide material facts in good faith in order to assist the government’s evaluation of its risk in order to provide you a positive determination to launch the payload with a future licensed launch services provider.” Christopher D. Johnson, *The Curious Case of the Transgressing Tardigrades (Part 2)*, SPACE REV. (Sept. 3, 2019), <https://www.thespacereview.com/article/3786/1>.

SpaceX.¹⁰ Even if, as was the case, the Arch Mission Foundation decided to add tardigrades to the lunar library at the last minute, SpaceIL would still have been required to report any change in payload contents to the FAA.¹¹ But *Beresheet's* new passengers went unreported and made it to the surface of the Moon along with the lander's remains. It appears likely that the lunar library and the dehydrated tardigrades stored in the strong resin between its layers survived the crash landing.¹²

The "Tardigrades Affair" is concerning for two interconnected reasons. First, it raises questions about the preservation and ethical exploration of space. The introduction of any Earth-origin biological materials into an extraterrestrial environment implicates the international law of planetary protection, which "collectively refers to the set of policies and practices designed to maintain the present and future scientific value of potential habitats from deterioration caused by terrestrial biological contamination ('forward contamination'), as well as to protect Earth's biosphere from any potentially harmful extraterrestrial organisms found in returned samples

10. See Hanneke Weitering, *SpaceX Rocket Launches 1st Private Moon Lander for Israel*, SPACE.COM (Feb. 22, 2019), <https://www.space.com/spacex-israeli-moon-lander-satellites-launch-success.html> (noting *Beresheet* was launched from Cape Canaveral Air Force Station in Florida).

11. See 14 CFR § 415.63 (2019) ("However, any change in information provided under section 415.59 of this subpart must be reported in accordance with section 413.17 of this chapter. The FAA determines whether a favorable payload determination remains valid in light of reported changes and may conduct an additional payload review.") In all situations, the duty is on the entities requesting a launch license from the FAA (in this case, SpaceIL and SpaceX) "to ensure that the application is accurate and complete." Johnson, *supra* note 9. "There is an affirmative duty on the part of the payload owner or operator to disclose material facts as part of the launch license application record." *Id.*

12. See Oberhaus, *supra* note 6 ("Based on their analysis of the spacecraft's trajectory and the composition of the lunar library, Spivack says he is quite confident that the library . . . survived the crash mostly or entirely intact."). See also Mindy Weisberger, *There Are Thousands of Tardigrades on the Moon. Now What?*, LIVESCIENCE (Aug. 15, 2019), <https://www.livescience.com/moon-tardigrades-future.html> ("If [the tardigrades] landed in a spot on the moon shielded from UV radiation, the microscopic creatures might stand a chance of survival, [University of Puget Sound Associate Professor of Biology Mark Martin] said.").

(‘backward contamination’)”¹³ While the Moon’s stark environment might not provide much for a few thousand dehydrated tardigrades to contaminate, what if *Beresheet* had been a Mars lander? Given signs of Mars’s habitability, planetary protection regulations for missions to Mars are tighter than those for lunar missions.¹⁴ Planetary protection laws preventing forward contamination are critical for scientific exploration of outer space bodies, so that their natural environments may be studied without Earth contamination interfering with actual or potential native life forms.¹⁵ Scientists have an interest in ensuring that any biological samples uncovered in extraterrestrial environments in fact originated there, rather than on Earth.¹⁶ Planetary protection also serves an ethical purpose: Unfettered space exploration hearkens dangerously back to humanity’s colonial past, in which more powerful actors asserted dominion over other regions and peoples, devastating natural environments and spreading disease among communities in the process.¹⁷ Planetary protection policy helps ensure that space exploration is done responsibly. Finally, planetary protection is an important means of addressing the “tragedy of the commons” in space exploration: If one

13. Andreas Frick et al., *Overview of Current Capabilities and Research and Technology Developments for Planetary Protection*, 54 *ADVANCES SPACE RES.* 221, 222 (2014).

14. See Bergit Uhran et al., *Updating Planetary Protection Considerations and Policies for Mars Sample Return*, 49 *SPACE POL’Y* 1, 2 (2019) (“[I]t is not possible at this time to rule out the possibility of life forms in Mars. On the contrary, recent robotic missions to the red planet have revealed a geologic history that suggest Mars was habitable in ancient times and might even today have locations that are habitable to different forms of terrestrial microbiology.”).

15. A. Coustenis et al., *The COSPAR Panel on Planetary Protection Role, Structure and Activities*, 205 *SPACE RES. TODAY* 14, 17 (2019).

16. See *id.* at 16 (noting a hypothetical example of the discovery of life on Mars challenged by the possibility of this life having been brought from Earth via a robotic mission).

17. See Christopher D. Johnson, *The Curious Case of the Transgressing Tardigrades (Part 3)*, *SPACE REV.* (Sept. 16, 2019), <https://www.thespacereview.com/article/3794/1> (“Underneath the issues of planetary protection and compliance with FAA payload review regulations is a broader concern . . . [i]t is tied to anxiety over historical issues such as imperialism and colonialism. Space exploration often features as part of a historical narrative for States undertaking exploration and ‘conquering’ new places for their own national pride and glory.”).

rogue actor contaminates an extraterrestrial body with biological materials from Earth, then future exploration of this body is compromised for every other spacefaring nation.¹⁸

Second, this affair draws attention to regulatory gaps in the governance of private space actors. Even if the tardigrades *had* been noted in SpaceIL's payload review application, including them in the lunar library likely would not have violated any planetary protection regulations.¹⁹ The critical fact, though, is that the Arch Mission Foundation unilaterally determined that including tardigrades was acceptable when this decision should have been made by a government agency. This is emblematic of growing concerns over the regulation of private space actors. The United Nations Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) makes States responsible for the acts of their national entities in space, whether government agencies or private organizations.²⁰ Therefore, States Parties to the Outer Space Treaty have an international obligation to regulate their private space sectors. In the case of *Beresheet*, both the U.S. and Israel likely had joint responsibility for this mission

18. See George Profitiliotis & Maria Loizidou, *Planetary Protection Issues of Private Endeavours in Research, Exploration, and Human Access to Space: An Environmental Economics Approach to Forward Contamination*, 63 *ADVANCES SPACE RES.* 598, 600 (2019) (“[A] failure to adhere to forward contamination mitigation requirements by one nation could have deleterious impacts to the present and future astrobiological research of every other nation”).

19. *Beresheet* was classified as a Category II Mission within the Committee on Space Research (COSPAR)'s planetary protection guidelines, for which only simple documentation is required. See NASA PLANETARY PROT. INDEP. REVIEW BD., REPORT TO NASA/SMD 12, 32–32 (2019) [hereinafter PPIRB REPORT] (summarizing COSPAR's requirements for different mission categories).

20. See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. VI, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 (entered into force Oct. 10, 1967) [hereinafter Outer Space Treaty] (“States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty.”).

under international law.²¹ However, they failed to regulate the mission in order to avoid the potential “harmful contamination” of a celestial body as required in Article IX of the Outer Space Treaty.²² If biological materials in a payload can be overlooked in this situation, then they can be overlooked in the future, an increasingly likely possibility as private companies cut corners to profit in the competitive space exploration industry.²³ Commercial space activities have not implicated planetary protection policy in the past, given that traditional private space activities, mainly the operation of communications satellites, have not engaged with extraterrestrial bodies like planets, moons or asteroids.²⁴ This is rapidly changing, however, with growing private interest in NewSpace activities like transport to the lunar surface and missions to Mars.²⁵

21. See Johnson, *supra* note 1 (“Consequently, while the US government reviewed the activities of the Beresheet mission, this mission was also a national activity of Israel, at least to the same extent (if not more so) than they were US national activities.”).

22. Outer Space Treaty, *supra* note 20, art. IX (“States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination . . .”).

23. See generally Nola Taylor Redd, *Will Private Companies Beat NASA to the Moon?*, SPACE.COM (July 31, 2019), <https://www.space.com/nasa-private-companies-moon-race.html> (noting several companies that have set ambitious goals for private space missions).

24. See NAT’L ACADS. OF SCIS., ENG’G, AND MED., REVIEW AND ASSESSMENT OF PLANETARY PROTECTION POLICY DEVELOPMENT PROCESSES 85 (2018) [hereinafter 2018 REVIEW AND ASSESSMENT] (“Traditional private-sector space activities, such as launching and operating communications satellites, do not generate planetary protection concerns.”).

25. U.S. companies SpaceX, Blue Origin, Moon Express, and Astrobotix have already indicated their interest in lunar missions and have begun preparation in this regard. Nola Taylor Redd, *Will Private Companies Beat NASA to the Moon?*, SPACE.COM (July 31, 2019), <https://www.space.com/nasa-private-companies-moon-race.html>. SpaceX is currently working on a vehicle called Starship, which it envisions carrying people to the Moon and Mars. *Id.* Additionally, Japanese company ispace is targeting a moon landing for 2021. Mike Wall, *Japanese Company ispace Now Targeting 2021 Moon Landing for 1st Mission*, SPACE.COM (Aug. 23, 2019), <https://www.space.com/japan-ospace-first-moon-mission-2021.html>. Indian company TeamIndus, another international player in lunar exploration, was a finalist in the Google Lunar X Prize competition and is now part of a consortium that has contracted with NASA to design and build a lander for the agency’s next lunar mission. T.E. Narasimhan, *Bengaluru Firm Team Indus to Design and Build Moon Lander for NASA*, BUS. STANDARD (June 7, 2019), <https://www.business-standard.com/>

With this in mind, the global community must find a way to ensure private space actors comply with planetary protection guidelines before forward contamination begins to threaten fragile extraterrestrial environments. The natural first place to turn for a solution is the source of current, voluntary international planetary protection guidelines: The Committee on Space Research (COSPAR). COSPAR was established by the International Council for Science (ICSU) in 1958 in order to “promote on an international level scientific research in space . . . and to provide a forum, open to all scientists, for the discussion of problems that may affect scientific space research.”²⁶ COSPAR began publishing guidelines for “planetary quarantine” shortly after its founding and in 1964 issued its Resolution 26.5 on sterilization of spacecraft, which formed the basis for its later policy on backward contamination.²⁷ In the decades since, COSPAR’s technical Panel on Planetary Protection has promulgated guidelines with specific requirements in order to protect against forward and backward contamination.²⁸ While COSPAR’s planetary protection guidelines are not legally binding, they serve as influential recommendations to spacefaring States adopting domestic policies on planetary protection, and have been endorsed by the United Nations Committee on the Peaceful Uses of Outer

article/companies/bengaluru-firm-team-indus-to-design-and-build-moon-lander-for-nasa-119060700668_1.html.

26. Comm. on Space Research [COSPAR], COSPAR Charter § I (June 1998), <https://cosparhq.cnes.fr/about/charter/> [hereinafter COSPAR Charter].

27. See John D. Rummel, Introduction to Planetary Protection: Goals, Rationales, and Sources of Policy Advice 2, 9 (Mar. 7, 2017), https://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb_178094.pdf (discussing key events in the international effort for planetary protection since the formation of COSPAR in 1958).

28. See, e.g., *Panel on Planetary Protection (PPP)*, COSPAR, <https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/> (last updated Apr. 6, 2021) (stating the membership, objectives, and upcoming meetings of the Panel on Planetary Protection). COSPAR’s Planetary Protection Policy is founded on two rationales: first, “the conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized,” and second, “[t]he Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from another planet.” Coustenis, *supra* note 15, at 16.

Space (COPUOS).²⁹ Thus, COSPAR is unable to directly impose its guidelines, which require implementation by States, on spacefaring entities. Such implementation is entirely voluntary, and COSPAR neither monitors nor enforces its guidelines.³⁰ As States have direct oversight and control over their own national space agencies, it is relatively easy for cooperating governments to ensure that those agencies follow the procedures set forth in COSPAR's planetary protection guidelines. The challenge is ensuring the same level of compliance among missions conducted by private space companies like Spacell, which are further removed from the government. As space activities are "the province of all mankind,"³¹ an international body like COSPAR has an important role to play in promoting planetary protection as the private space age dawns.

In exploring COSPAR's role in the international planetary protection regulatory landscape, this note will address three questions: first, *can* COSPAR bear the weight of being an international standard-setting body for increasing private sector space activity? Second, *should* the international community rely on COSPAR as a source of private sector planetary protection regulation, or would these policies be more effective if they originated elsewhere? Finally, *how* can the international community use the COSPAR policy framework to encourage planetary protection compliance among private space actors? This note will use the Tardigrades Affair to examine the practical consequences of any efforts to regulate private sector space activity through COSPAR. Part II will review COSPAR's organization, the process by which its Panel on Planetary Protection issues guidelines, and the contents of those guidelines. Part III will answer the *can* question, highlighting a number of obstacles that prevent COSPAR's policy from being as effective as it could be. Part IV answers the *should* question, concluding that an international body such as COSPAR is best suited to regulate in this area. Part V addresses the *how* question, recom-

29. Coustenis, *supra* note 15, at 18–19 ("Space agencies globally have maintained compliance with the Outer Space Treaty by following the COSPAR Planetary Protection Policy.").

30. See *Panel on Planetary Protection (PPP)*, *supra* note 28 ("It is not the purpose of the Panel to specify the means by which adherence to the COSPAR planetary protection policy is achieved . . .").

31. Outer Space Treaty, *supra* note 20, art. I.

mending a number of pathways forward for COSPAR and its planetary protection policy. Part VI will conclude.

II. COSPAR AT A GLANCE

A. *The Organization of COSPAR*

COSPAR is one of the scientific committees of the ICSU tasked with promoting space research through “the organization of scientific assemblies, publications or any other means.”³² COSPAR consists of two kinds of members: National Scientific Institutions (e.g., the National Academies of Sciences, Engineering, and Medicine in the United States) and International Scientific Unions (e.g., the International Mathematical Union).³³ Members appoint a representative of their institution or union to COSPAR, and this representative has voting rights.³⁴ COSPAR is governed by a Council consisting of the president, representatives of its member National Scientific Institutions and International Scientific Unions, chairs of the COSPAR Scientific Commissions, and the chair of the COSPAR Finance Committee.³⁵ Between Council meetings, a Bureau, made up of the president and vice president of COSPAR and six other members elected by the Council, manages COSPAR’s day-to-day affairs.³⁶

Additionally, individual scientists may become COSPAR “associates” by communicating their interest or attending a COSPAR event.³⁷ Public or private organizations or individuals may become “associated supporters” by paying an adherence fee.³⁸ Examples of supporters include Lockheed Martin Corporation and Northrop Grumman, both private companies in

32. COSPAR Charter, *supra* note 26, § I.

33. *Id.*

34. COSPAR Council, COSPAR By-Laws art. II (Jan. 29, 2021), <https://cosparhq.cnes.fr/about/by-laws/> [hereinafter COSPAR By-Laws].

35. COSPAR Charter, *supra* note 26, § IV.

36. *Id.*

37. COSPAR By-Laws, *supra* note 34, art. IX. Associates take part in COSPAR Scientific Commissions and vote on all matters brought to a vote during scientific or business meetings of the Scientific Commissions of which they are members. *Id.*

38. *Id.* art. X.

the aerospace industry.³⁹ As the Committee on the Review of Planetary Protection Policy Development Processes of the National Academy of Sciences' Space Studies Board (SSB Committee) acknowledges, "[i]n short, COSPAR has an open process in terms of membership and participation in policy decision making," with very few barriers to entry for entities interested in space research.⁴⁰

COSPAR's biennial Scientific Assemblies are central to its organization. During these Assemblies, Scientific Commissions meet to discuss different areas of space research (e.g. Scientific Commission A on Space Studies of the Earth's Surface, Meteorology, and Climate).⁴¹ Within these Commissions, sub-commissions and task groups may be established on an ad hoc basis.⁴² The public work of the Commissions takes the form of resolutions, which must be endorsed in writing by a majority of Commission members present.⁴³ In addition to its eight Scientific Commissions, COSPAR has ten technical panels on specific subjects in space research,⁴⁴ one of which is the Panel on Planetary Protection (PPP).

B. *COSPAR's Panel on Planetary Protection*

The primary objective of the PPP is to "develop, maintain, and promulgate clearly delineated policies that provide specific requirements as to the standards that must be achieved to protect against the harmful effects of [forward and backward] contamination."⁴⁵ These policies "must be based upon the most current, peer-reviewed scientific knowledge, and should be based upon the principle that COSPAR planetary protec-

39. See *Associated Supporter Program*, COSPAR, <https://cosparhq.cnes.fr/associated-supporters/> (last updated Jan. 13, 2021) (listing the public and private organizations that are COSPAR Associated Supporters).

40. 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 73. The SSB Committee likens COSPAR to "community-based ad hoc organizations," like NASA's Mars Exploration Program Analysis Group, which differentiates it from formally organized advisory entities such as the NASA Advisory Council. *Id.*

41. *Scientific Commission A: Space Studies of the Earth's Surface, Meteorology, and Climate*, COSPAR, <https://cosparhq.cnes.fr/scientific-structure/scientific-commissions/scientific-commission-a-space-studies-of-the-earth-s-surface-meteorology-and-climate/> (last updated Mar. 1, 2021).

42. COSPAR By-Laws, *supra* note 34, art. XII.

43. *Id.* art. XI.

44. Coustenis, *supra* note 15, at 16.

45. *Panel on Planetary Protection (PPP)*, *supra* note 28.

tion policies should enable the exploration and use of the solar system, not prohibit it.”⁴⁶ As mentioned earlier, COSPAR’s planetary protection policy is advisory rather than legally binding. The PPP does not specify how best to promote adherence to its policy, leaving this up to the organizations responsible for planetary missions. However, the PPP does encourage the exchange of information on best practices in its meetings.⁴⁷

The PPP is led by a chair and two vice chairs. Membership is split evenly between representatives of the national or international authorities responsible for compliance with the Outer Space Treaty (e.g. NASA) and scientists representing COSPAR Scientific Commission B (Space Studies of the Earth-Moon System, Planets and Small Bodies of the Solar System) and Scientific Commission F (Life Sciences as Related to Space).⁴⁸ The chair is selected for their leadership in the field of international space science and may not represent a national or international authority responsible for Outer Space Treaty compliance.⁴⁹ One vice chair is chosen for their expertise on planetary protection issues and may also be a representative of a national or international space authority, while the other is appointed by the U.N. Office for Outer Space Affairs (UNOOSA) to ensure that COSPAR is fulfilling its Outer Space Treaty responsibilities.⁵⁰

The PPP meets regularly to review the best available science on planetary protection and update its policies in light of new information. COSPAR Bureau, Council, or associate members may present issues with the planetary protection policy to the Panel and the chair of the PPP may in turn convene a workshop or colloquium to discuss the merits of the issue and any proposed amendments to the policy.⁵¹ After the policy language has been refined by the relevant workshop or colloquium, amendments proposed by members are brought before the PPP. If no members object, the amendment is approved and passed on to the COSPAR Council.⁵² If the Coun-

46. *Id.*

47. *Id.*

48. *Id.*

49. *Id.*

50. *Id.*

51. See 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 73.

52. *Id.*

cil subsequently approves the amendment, the official COSPAR planetary protection policy is formally updated.⁵³

C. COSPAR's Planetary Protection Policy⁵⁴

COSPAR's guidelines separate space missions into five categories. Category I includes "any mission to a target body which is not of direct interest for understanding the process of chemical evolution or the origin of life."⁵⁵ Category II covers missions to bodies that are of interest relative to the origin of life where there is "only a remote chance that contamination carried by a spacecraft could compromise future investigations."⁵⁶ Category III comprises activities, like flyby or orbiter missions, where there is no contact between the spacecraft and a target body which is of interest relative to the origin of life, but where the mission could still potentially pose a contamination risk.⁵⁷ Category IV consists of certain missions (primarily missions where a lander contacts the surface) to the same bodies as Category III.⁵⁸ Category V covers all missions in which the spacecraft will ultimately return to Earth. Category V is further subcategorized into "unrestricted Earth return," missions that have planetary protection requirements for their outbound phases only, and "restricted Earth return" missions with protections for both the outbound and inbound phases.⁵⁹ The

53. *Id.*

54. COSPAR's Planetary Protection Policy was most recently updated in June 2020. COSPAR Panel on Planetary Protection, *COSPAR Policy on Planetary Protection*, 208 SPACE RES. TODAY 10 (2020) [hereinafter Planetary Protection Policy].

55. *Id.* at 10. Missions to bodies such as Jupiter's moon Io and undifferentiated, metamorphosed asteroids are classified as Category I. *Id.* at 13.

56. *Id.* at 11. Missions to Venus and the Moon are classified as Category II, as are missions to all of the gaseous planets of the solar system, comets, and certain types of asteroids. *Id.* at 13.

57. *Id.* at 11. Examples in Category III include flyby and orbiter missions to Mars, Jupiter's moon Europa, and Saturn's moon Enceladus. *Id.* at 14.

58. *Id.* at 11. Examples in Category IV include lander missions to Mars, Europa, and Enceladus. *Id.* at 14.

59. *Id.* at 11. Return missions to the Moon and Venus fall into the "unrestricted Earth return" subcategory, while Mars and Europa require "restricted Earth return." *Id.* at 14.

latter present the most concern for backward contamination upon the spacecraft's return to Earth.⁶⁰

For each category of mission, the guidelines specify the required planetary protection measures. For Category I missions, no planetary protection requirements are imposed.⁶¹ Category II missions require only a short planetary protection plan and pre- and post-launch analyses detailing strategies for the mission's impact with the target body.⁶² Category III missions require more documentation than those in Category II, as well as the implementation of protective procedures. These include the use of cleanrooms during spacecraft assembly in addition to the listing and testing of all organics onboard if it is possible the spacecraft could make contact with the target body (though these are not intended as lander missions).⁶³ Category IV requires more detailed documentation than Category III, as well as an increased number of implementation procedures, careful inventory of organics onboard, and possible sterilization of the hardware making direct contact with the target body.⁶⁴ Lastly, Category V's "unrestricted Earth return" missions apply only those procedures required by the classification of their outbound phases (e.g., an Earth-return mission to the Moon would need only Category II documentation), while "restricted Earth return" missions have stringent requirements for the containment of any hardware that made contact with the target body as well as any unsterilized samples that were brought back to Earth.⁶⁵ COSPAR policy further recommends its members inform COSPAR of the planetary pro-

60. *See id.* at 11 ("For all other Category V missions, in a subcategory defined as 'restricted Earth return,' the highest degree of concern is expressed . . .").

61. *Id.* at 10.

62. *Id.* at 11.

63. *Id.*

64. *Id.*

65. *See id.* (proscribing the "absolute prohibition of destructive impact upon return, the need for containment throughout the return phase of all returned hardware which directly contacted the target body or unsterilized material from the body, and the need for containment of any unsterilized sample collected and returned to Earth").

tection measures taken after a space mission has been completed.⁶⁶

III. CAN COSPAR BEAR THE WEIGHT OF BEING A STANDARD-SETTING BODY IN THE AGE OF PRIVATE SPACE EXPLORATION?

Since its advent in the mid-20th century, COSPAR has enjoyed great respect internationally. Elements of its planetary protection guidelines have made their way into a number of national space agencies' own policies, primarily on an ad hoc basis. Despite COSPAR's reputation, there has been no major international push to adopt its guidelines in all spacefaring nations. As commercial entities begin exploring extraterrestrial bodies, however, domestic regulation worldwide must respond swiftly, and it is certainly beneficial to have a standardized international policy upon which to base these regulations. This Part will explore whether COSPAR is currently equipped to act as a standard-setting body for regulation of the private sector.

A. *International Compliance with COSPAR Guidelines*

1. *Compliance for Government-Sponsored Space Missions*

Many national space agencies apply planetary protection policies which closely mirror COSPAR guidelines.⁶⁷ In the United States, NASA takes care to underscore the close relationship between domestic regulations and COSPAR policies by using the same categories and requirements.⁶⁸ COSPAR's

66. *See id.* at 12 (COSPAR recommends "COSPAR members provide information to COSPAR within a reasonable time not to exceed six months after launch . . .").

67. *See* 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 72 ("For example, all missions of the European Space Agency (ESA) have complied with COSPAR guidelines. Japanese missions have also followed COSPAR guidelines. The same can be said for certain Russian missions, India's Mars orbiter mission, and the United Arab Emirates' Hope Mars Orbiter mission, scheduled for launch in March 2020.")

68. *See* OFFICE OF SAFETY AND MISSION ASSURANCE, NASA, NPR 8020.12D, PLANETARY PROTECTION PROVISIONS FOR ROBOTIC EXTRATERRESTRIAL MISSIONS ch. 1.3.1 (2011) ("The objectives of NASA's planetary protection policy, which is consistent with the policy and guidelines of the Committee on Space Research (COSPAR), shall be met at all times."). At the time of the *Beresheet* mission NPR 8020.12D was superseded by NID 8020.109A, which had the same categorization and requirements. *See* OFFICE OF SAFETY AND

most recent planetary protection policy issued in June 2020 was brought closer in line with NASA's by including specific and detailed planetary protection guidance for missions to the icy moons of the outer solar system, and the two are now very similar.⁶⁹

Similarly, the European Space Agency (ESA) introduced a comprehensive planetary protection policy based on COSPAR guidelines in 2007.⁷⁰ The Japan Aerospace Exploration Agency (JAXA) operates a planetary protection standardization working group within its Department of Safety and Mission Assurance to ensure JAXA aligns with COSPAR policy.⁷¹ Though no information is publicly available about the China National Space Administration (CNSA)'s planetary protection policy, information provided by the China Academy of Space Technology suggests that CNSA classifies its missions according to the COSPAR categories and complies with each category's respective planetary protection requirements.⁷² Information about Roscosmos' planetary protection policy is likewise unavailable, but Russian law prohibits "harmful contamination of outer space which leads to unfavourable changes of the environment"⁷³ Further, in 2011, Roscos-

MISSION ASSURANCE, NASA, NID 8020.109A, PLANETARY PROTECTION PROVISIONS FOR ROBOTIC EXTRATERRESTRIAL MISSIONS ch. 1.3.1 (2017) ("The objectives of NASA's planetary protection policy, which is consistent with the policy and guidelines of the Committee on Space Research (COSPAR), shall be met at all times."). NID 8020.109A has since expired, and NPR 8020.12D is NASA's current policy. *See id.* (expiring June 1, 2019).

69. *See* Planetary Protection Policy, *supra* note 54, at 8 (detailing planetary protection requirements for missions to Europa and Enceladus specifically).

70. *See* Gerhard Kminek, Planetary Protection Officer, European Space Agency, Planetary Protection at ESA 3 (July 10, 2018), http://pposs.org/wp-content/uploads/2018/07/PPOSS_Planetary-Protection-at-ESA_V2.pptx ("This 'ESA Planetary Protection Policy', complies with the COSPAR planetary protection policy and the corresponding implementation guidelines[.]").

71. PLANETARY PROTECTION OF OUTER SOLAR SYS., THE INTERNATIONAL PLANETARY PROTECTION HANDBOOK 112–13 (Jean-Louis Fellous ed., 2018).

72. *See* Peng Jing, China Acad. of Space Tech., Technology Development and Prospects of Planetary Protection 8 (Oct. 2018), <http://pposs.org/wp-content/uploads/2018/10/7.-Planetary-Protection-at-CAST.ppt> (mapping China's space missions to COSPAR categories).

73. U.N. Office for Outer Space Affairs, Selected Examples of National Laws Governing Space Activities: Russian Federation: Law of the Russian Federation "About Space Activity": Decree No. 5663-1 of the Russian House

mos complied with COSPAR planetary protection guidelines for its attempted Mars sample return mission, Phobos-Grunt.⁷⁴ The Indian Space Research Organization (ISRO), India's national space agency, complied with COSPAR planetary protection guidelines for its 2019 attempted lunar exploration mission Chandrayaan-2, as evidenced by the implementing agreement with NASA.⁷⁵

The implementation of COSPAR-influenced planetary protection policies by national space agencies suggests that COSPAR has enough clout worldwide to continue serving as a standard-setting body in this area. As noted earlier, under the Outer Space Treaty, governments are equally responsible for the conduct of their private sectors and government agencies in space. Thus, it makes sense that governments would seek to

of Soviets, https://www.unoosa.org/oosa/en/ourwork/spacelaw/national-spacelaw/russian_federation/decree_5663-1_E.html (last visited Apr. 11, 2021).

74. See 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 36 (“During the second meeting, the NASA and ESA officials signed a formal set of documents agreeing that Roscosmos’s proposed approach—that is, treating Phobos-Grunt as if it were a restricted Earth return mission—was consistent with COSPAR guidelines.”). Phobos-Grunt was a particularly challenging case from a planetary protection perspective because it carried a Living Interplanetary Flight Experiment (LIFE) capsule containing terrestrial organisms, which would test to see if terrestrial life could survive exposure to the space environment during the flight to Mars and were meant to make the mission’s full round trip to the Martian moon Phobos before returning to Earth. *Id.* at 35–36. Phobos-Grunt ultimately failed to respond to commands from the ground shortly after launch into Earth orbit and fell back to Earth before it could commence its journey to Mars. *Id.*

75. See Implementing Arrangement Between the Indian Space Research Organization of the Republic of India and the National Aeronautics and Space Administration of the United States of America for Cooperation on the Chandrayaan-2 Mission, India-U.S., art. 10, Feb. 11, 2019, <https://www.mea.gov.in/Portal/LegalTreatiesDoc/US19B3558-1.pdf> (“The Parties shall observe the guidelines contained in the Committee on Space Research (COSPAR) Planetary Protection Policy of 2011 (‘COSPAR Planetary Protection Policy’), as amended, in place as of the signature of this Implementing Arrangement.”). An implementing agreement was enacted because Chandrayaan-2 carried a NASA laser reflector in its payload. See Chelsea Gohd, *50 Years After Apollo, India is Carrying a NASA Laser Reflector to the Moon (and It’s Only the Start)*, SPACE.COM (July 26, 2019), <https://www.space.com/next-gen-apollo-moon-laser-reflector-on-india-mission.html> (“The reflectors, which are part of the Indian Space Research Organization’s (ISRO) Chandrayaan-2 mission . . . represent the next step in [a NASA] experiment that began in 1969.”).

implement the same COSPAR planetary protection standards in the private and public sectors. Naturally, though, this implementation would need to overcome pressure from the private sector, which may push against more regulation in the interest of maintaining profits.

2. *Compliance for Private Sector Space Missions*

Private space missions had not raised planetary protection concerns before *Beresheet*, so it is unclear how States enforce COSPAR's planetary protection rules for private sector missions or what policies States have in place to do so in the future. Planetary protection regulation for private space actors in the U.S. is weak at best. In authorizing the launch of *Beresheet*, the FAA conducted a cursory planetary protection review of any hazardous materials in the payload; however, it is not clear whether the FAA actually had the authority to do so.⁷⁶ While the FAA is empowered to regulate the *launch* and *reentry* of space objects, it expressly does not have any mandate to control the object's conduct once on orbit.⁷⁷ This creates a troubling regulatory gap, in which "[n]o federal regulatory agency has the jurisdiction to authorize and continually supervise on-orbit activities undertaken by private sector entities, including activities that could raise planetary protection issues."⁷⁸ The SSB Committee has emphasized that resolving this regulatory gap is essential for the development of planetary protection policy for the private sector.⁷⁹ The existence of a regulatory gap in the U.S., the country from which many commercial space missions are launched, suggests that other

76. See Laura Montgomery, *No Tardigrades Here*, GROUND BASED SPACE MATTERS (Aug. 22, 2019), <https://groundbasedspacematters.com/index.php/2019/08/22/no-tardigrades-here/> ("The FAA has somewhat murky authority over the payloads of launch and reentry operators, its licensees.").

77. See H.R. REP. NO. 105-347, at 22–23 (1998) ("The Committee wishes to make clear that the Secretary has no authority to license or regulate activities that take place between the end of the launch phase and the beginning of the reentry phase . . .").

78. 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 86.

79. See *id.* at 87 ("Despite legislative and executive branch attention to this issue, Congress has not, to date, eliminated the regulatory gap. Addressing this gap is a necessary prerequisite to the development and implementation of an effective planetary protection policy applicable to private-sector entities.").

States' laws may similarly be unequipped to implement COSPAR planetary protection rules for private sector missions, despite their willingness to apply these rules to government-sponsored missions. Indeed, a review conducted by the International Astronautical Foundation indicates that none of the prominent spacefaring countries have explicitly promulgated planetary protection regulations applicable to the private sector, with the exception of Russia.⁸⁰

On the other hand, when private entities partner with government agencies to conduct space missions, COSPAR policies *are* clearly applied to private sector activities. Private actors in these joint ventures are typically subject to the same planetary protection standards as the agency itself. NASA's Procedural Requirements emphasize that if NASA participates in a non-NASA mission, that mission's organizer, "whether governmental or private entity," must adhere to "appropriate policies, regulations, and laws regarding planetary protection that are generally consistent with the COSPAR Planetary Protection Policy and Guidelines."⁸¹ ESA's policy is the same.⁸² These rules ensure that COSPAR planetary protection standards will still be upheld as more private companies collaborate with government space agencies, whether they participate by supplying hardware or by taking a more active role, as SpaceIL did with state-owned Israel Aerospace Industries for *Beresheet*.⁸³ Missions that are entirely privately operated, however, may fall into regulatory gaps.

80. CARA P. CAVANAUGH ET AL., AN INTERNATIONAL PERSPECTIVE ON PLANETARY PROTECTION POLICIES 10 (2020).

81. OFFICE OF SAFETY AND MISSION ASSURANCE, NASA, NPR 8020.12D, PLANETARY PROTECTION PROVISIONS FOR ROBOTIC EXTRATERRESTRIAL MISSIONS ch. 2.2.2 (2011).

82. See Kminek, *supra* note 70, at 3 ("Spaceflight missions carried out with any degree of ESA involvement shall comply with this policy and its associated requirements[.]").

83. See *Successful Launch!*, ISR. AEROSPACE INDUS. (Feb. 24, 2019), <https://www.iai.co.il/successful-launch> ("This Friday morning, SpaceIL and IAI, the partners in the *Beresheet* project, announced the successful launch of the spacecraft.") (emphasis added). Though Israel Aerospace Industries engineers were involved in the operation of *Beresheet*, SpaceIL's own engineers collaborated extensively throughout preparation, launch, and orbit and the majority of the project's funding came from private donors and corporate investments rather than the government. See Mike Wall, *Israel's Beresheet Spacecraft Crashes into Moon During Landing Attempt*, SPACE.COM (Apr. 11, 2019), <https://www.space.com/israeli-beresheet-moon-landing-attempt-fails.html> (noting

B. *Problems with COSPAR*

Despite COSPAR's success in the age of government-sponsored space missions, there are a few problems that may hinder its chances of similar success in the private space age, namely: COSPAR's institutional design, the lack of private sector participation on the PPP, the restrictiveness of its guidelines, and the absence of a mechanism for monitoring compliance. While these obstacles are certainly not insurmountable, they should be considered as the organization explores ways to respond to the changing realities of space exploration.

1. *Institutional Design*

The individual commissions and panels within COSPAR's larger organizational structure have long functioned relatively informally, allowing attendance by anyone who wishes to contribute to a particular discussion. For some time, this was true of the PPP. The format presents certain vulnerabilities, notably the potential for the composition of participants at any given meeting to sway decision-making. As COSPAR's relevance increases due to the expansion of private space activity, its decisions will begin to affect a wider range of political and commercial interests. However, its quasi-ad hoc institutional structure may allow certain perspectives too much influence as entities and individuals join with the intention of advancing their policy agendas.

Several different analytical frameworks can help explain COSPAR's institutional design and its weaknesses. Using Benedict Kingsbury's categorization of distributed administration systems,⁸⁴ COSPAR primarily functions as a "symbiote," in that it "rel[ies], for operationalization of [its] standards or decisions, on other entities that are not members and that have a separate existence for other purposes."⁸⁵ In COSPAR's case,

how IAI and SpaceIL worked together on the attempt to become the first privately funded mission to land on the moon).

84. Distributed administration refers to situations in which one entity's standards or decisions (in this case, the COSPAR Planetary Protection Policy) are "given practical effect by national or non-territorial entities interpreting, varying, implementing and enforcing them, or by companies specialized in certification, verification, inspection or audit." Benedict Kingsbury, *Three Models of "Distributed Administration": Canopy, Baobab, and Symbiote*, 13 INT'L J. CONST. L. 478, 478 (2015).

85. *Id.* at 480.

these “other entities” are twofold: the national legislatures or regulatory agencies that must enact the COSPAR policy into law, and the spacefaring entities, whether governmental or commercial, that must take action to ensure their missions comply with COSPAR standards. The term “symbiote” implies reciprocity, and the connection between COSPAR and these other entities is sometimes tenuous. Not all entities responsible for implementing COSPAR standards are members of the PPP, particularly commercial space companies planning to conduct missions to extraterrestrial bodies in the future. Governments are represented through their national space agencies, but not by any representatives who can legislate with the interests of the private sector in mind. COSPAR and its symbiotic entities may need to strengthen their relationship so that all relevant stakeholders are represented effectively before it can succeed through this type of distributed administration.

Further, COSPAR’s planetary protection processes largely fit Gráinne de Burca, Robert O. Keohane, and Charles Sabel’s criteria for “experimentalist governance.” Experimentalist governance “describes a set of practices involving open participation by a variety of entities (public or private), lack of formal hierarchy within governance arrangements, and extensive deliberation throughout the process of decision making and implementation.”⁸⁶ Its five “crucial identifying features” are (1) openness to participation of stakeholders in a non-hierarchical process of decision making, (2) articulation of a common problem with open-ended goals, (3) implementation by lower-level actors with local or contextualized knowledge, (4) continuous feedback, reporting, and monitoring, and (5) established practices for revising rules and practices.⁸⁷ COSPAR’s processes are open to participation by stakeholders in the space exploration landscape through a non-hierarchical process (representatives from national space agencies do not have higher standing on the PPP than unaffiliated scientists, for example); it has articulated a broad common problem of protecting extraterrestrial bodies (and, correspondingly, Earth) from harmful contamination; it relies on implementation by actors at the State level; there is some level of continuous re-

86. Gráinne de Búrca, Robert O. Keohane, & Charles Sabel, *New Modes of Pluralist Global Governance*, 45 N.Y.U. J. INT’L L. & POL. 723, 738 (2013).

87. *Id.* at 739.

porting and monitoring; and the panel is constantly reviewing and revising their rules based on new information. While the PPP possesses all five features of experimentalist governance to some extent, certain COSPAR methods are less effective than others, which might impact COSPAR's ability to successfully govern in this way. COSPAR does recommend that its members report on the planetary protection procedures they take for each mission, but this reporting is voluntary.⁸⁸ COSPAR does not actively monitor planetary protection compliance worldwide. If COSPAR were to strengthen its monitoring and reporting procedures, it might be more effective as an entity applying experimentalist governance.

In spite of these weaknesses, institutional reform efforts have already begun within COSPAR. For example, the current structure of the PPP is a product of a 2017 reform aimed at bringing a new level of formality to its procedures.⁸⁹ This was necessary due to the PPP's unique mandate which effectively made it responsible for guiding compliance with Article IX of the Outer Space Treaty.⁹⁰ Previously, the PPP had no formal membership aside from its chairs and vice chairs, which meant that participation was based entirely on who chose to attend its meetings.⁹¹ The 2017 reform designated spots on the panel for national space agency-appointed scientists. The formalization of PPP membership ensured that those directly affected by the content of the planetary protection policy have a

88. See PPIRB REPORT, *supra* note 19, at 33 (“COSPAR . . . [r]ecommends that COSPAR members provide information to COSPAR within a reasonable time not to exceed six months after launch about the procedures and computations used for planetary protection for each flight and again within one year after the end of a solar- system exploration mission about the areas of the target(s) which may have been subject to contamination.”).

89. Lennard A. Fisk, President, COSPAR, Planetary Protection: The COSPAR Perspective, Presentation to the Committee on the Goals, Rationales, and Definition of Planetary Protection 13–18 (June 28, 2017), https://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb_180773.pdf.

90. See *id.* at 13 (“[U]nlike any other panel [the PPP] effectively had statutory responsibilities to determine the international standards for planetary protection to guide compliance with Article IX of the Outer Space Treaty.”).

91. 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 73.

proper say in its formation.⁹² This change might indicate COSPAR's internal willingness to move toward further reform.

2. *Lack of Participation in Decision-Making*

Participation in the PPP's processes may present another major hurdle to the implementation of its planetary protection policy in domestic commercial regulations. First, there has historically been a lack of participation in the panel's decision-making, with few scientists attending the meetings at which the PPP considers how its policy will respond to new scientific findings.⁹³ Without a wide range of voices contributing to policy development, it is difficult to say that any resulting amendments reflect true consensus among all relevant stakeholders. The recent 2017 reform of the PPP's membership may help solve this problem moving forward.

Even more significant is the lack of private sector participation in PPP decision-making. The dearth of commercial voices up to this point is understandable, as private companies were not previously involved in the exploration of extraterrestrial bodies and thus did not generate planetary protection concerns. However, this is rapidly changing. Though COSPAR's president has emphasized that supporting the needs of non-governmental entities is a goal of the Panel,⁹⁴ there is no formal mechanism in place for direct participation of the private sector in PPP policy development. While COSPAR's openness means commercial entities *may* send representatives to attend its colloquia, workshops, and policy-making delibera-

92. See Fisk, *supra* note 89, at 14 ("We have thus been engaged over the last few years in reconstituting the PPP, to introduce a formality that ensures that all parties that comply with the COSPAR Planetary Protection Policy have a proper say in the formation of the Policy . . .").

93. See 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 75 ("COSPAR [has] not always been successful at recruiting a wide range of scientists to participate in meetings where new scientific findings are considered for their implications for planetary protection policy. In addition to the need to expand scientific participation in COSPAR planetary protection colloquia and workshops, the level of participation in the meetings of COSPAR's Panel on Planetary Protection has been uneven in the past.").

94. See Fisk, *supra* note 89, at 14 ("Although we started consideration of reconstituting the PPP mainly to be sure that COSPAR is properly supporting the needs of space agencies, we are creating a structure that should also be able to support the needs of non-governmental entities.").

tions, few companies have taken advantage of this.⁹⁵ Perhaps allocating designated seats on the Panel for private sector enterprises interested in exploration of solar system bodies, the way the 2017 reform allocated seats for national space agency representatives, would formalize the private sector's role in the panel enough to encourage more frequent participation. The SSB Committee also suggested COSPAR could partner with an organization that already has a high level of private sector participation, like the International Astronautical Federation.⁹⁶ Regardless of method, stronger commercial participation in COSPAR decision-making is necessary to ensure the representation of private sector stakeholders who will be affected by domestic planetary protection regulations based on the COSPAR policy.

3. *Unnecessarily Restrictive Guidelines*

Some contend that the private space sector is already overregulated. An argument against applying COSPAR standards to private sector space activities is that these requirements are too restrictive; the increase in mission costs, advocates argue, would disincentivize private space exploration and perhaps quell it altogether.⁹⁷ Some critics believe that forward contamination rules are unnecessary because scientists would easily be able to determine whether a given lifeform found on an extraterrestrial body originated there or on Earth; thus, there is no need to worry about carrying living organisms to other planets.⁹⁸ Further, critics argue that exploration of outer space is for the benefit of all humanity, not merely the re-

95. As of January 2021, COSPAR has only six Associated Supporters and two Industry Partners. *Associated Supporter Program*, COSPAR, <https://cosparhq.cnes.fr/associated-supporters/> (last updated Jan. 13, 2021) .

96. 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 89.

97. See Jeff Foust, *New Challenges for Planetary Protection*, SPACE REV. (June 12, 2017), <https://www.thespacereview.com/archive/3260-1.html> (“The sense of industry is that the current planetary protection requirements . . . are not set up to enable commercialization, particularly with commercial human spaceflight,’ [Ryan Noble of Bigelow Aerospace, Chair of the Commercial Spaceflight Federation’s regulatory committee] said.”).

98. Robert Zubrin, *The Tardigrades-on-the-Moon Affair*, NAT’L REV. (Aug. 31, 2019), <https://www.nationalreview.com/2019/08/planetary-protection-rules-hamper-space-exploration/> (“As for the objection that if we send humans to Mars we won’t know if the life we find there is native or something we brought ourselves, it is nonsense. If it is native life, it will have left

search interests of astrobiologists, so science should not be our sole concern when exploring and exploiting other worlds.⁹⁹ In line with this thinking, one can argue that COSPAR standards must be softened before they are implemented in private sector regulations—or, not implemented in such regulations at all. This would ensure that commercial space activities continue to enrich humanity through exploitation of valuable resources or exploration of potentially habitable worlds. Should this perspective gain force, it may affect States' willingness to apply COSPAR requirements to their private sectors.

4. *No Mechanism for Monitoring Compliance*

A final overarching issue with COSPAR's PPP is that it does not include any mechanism for monitoring State compliance. COSPAR has repeatedly denied any role in implementing its guidelines.¹⁰⁰ Compliance was not a serious problem when extraterrestrial missions were conducted solely by government agencies, since governments have direct control over the activities of their agencies and can voluntarily ensure that these activities comply with COSPAR standards. Further, since national space agencies are represented on the PPP and regularly report back about their missions, it is easier to assess compliance in these cases. Private space activities complicate the landscape significantly. Since the COSPAR standards are voluntary, bringing private space missions into compliance requires an additional step: national legislation or regulation on planetary protection governing commercial space activities. As private missions increase in frequency and as companies from a greater number of spacefaring States conduct them, determining whether missions adhere to COSPAR standards will be

fossils or other biomarkers to prove its existence on Mars before our arrival.”).

99. *See, e.g., id.* (“It’s not just a matter of who gave the Moon to astrobiologists, but also of who gave the universe to professional scientists. Humans do not exist to serve scientific research. Scientific research exists to serve humanity. We learned a lot of science by settling America, but that’s not why we did it. We will acquire vast new knowledge by becoming a spacefaring species, but that is not why we should do it.”).

100. *See Coustenis, supra* note 15, at 25 (“It is not the job of the COSPAR PPP to suggest ways to implement the requirements. Implementation of the COSPAR Planetary Protection Policy is left to the agencies or organizations planning and executing the missions.”).

far more complicated. Without a mechanism for monitoring compliance, COSPAR will be unable to track whether domestic regulations are implemented in line with COSPAR policy and States will have less incentive to enact such regulations and strictly enforce them. This situation may perpetuate regulatory gaps, like the FAA's limited jurisdiction in the United States. Future *Beresheet*-like incidents could escape oversight, not because spacefaring governments are opposed to planetary protection in theory, but because they have not taken the steps necessary to incorporate COSPAR policies into national law.

C. *Comparison to Other International Standards*

To determine COSPAR's fitness for the regulatory task ahead, it is useful to examine other similar international standards; specifically, the International Civil Aviation Organization (ICAO)'s Standards and Recommended Practices (SARPs), the Codex Alimentarius, and the Space Debris Mitigation Guidelines. The following standards were, like the COSPAR policy, issued as non-binding soft law recommendations and have since seen strong levels of compliance not only by governments, but the private sector as well. This section compares these successful standards to the COSPAR guidelines and assesses whether COSPAR could emulate their respective trajectories.

1. *ICAO SARPs*

The SARPs issued by ICAO are a frequently cited example of soft law that has achieved binding character due to its widespread influence on domestic law.¹⁰¹ SARPs are intended to promote uniformity in international aviation practice. They take the form of technical specifications in areas like personnel licensing, aeronautical charts, aircraft registry, accident investigation, environmental protection, and safety and security.¹⁰² Just as COSPAR guidelines are issued pursuant to Article

101. See Paul Stephen Dempsey, *Compliance & Enforcement in International Law: Achieving Global Uniformity in Aviation Safety*, 30 N.C. J. INT'L L. & COM. REG. 1, 14–18 (2004) (discussing the SARPs' status as soft versus hard law and noting States' widespread acceptance of the standards).

102. SEE Int'l Civil Aviation Org. [ICAO], THE CONVENTION ON INTERNATIONAL CIVIL AVIATION: ANNEXES 1 TO 18, <https://www.icao.int/safety/>

IX of the Outer Space Treaty, SARPs are issued to guide States in complying with Article 37 of the Convention on International Civil Aviation (Chicago Convention).¹⁰³ SARPs are not technically binding, as suggested by the name “*Recommended Practices*”—rather, their legal force is strongest when States adopt them as regulations within their national aviation codes.¹⁰⁴ In part, SARPs are so effective because compliance is often a prerequisite for exercising air traffic rights within another State’s airspace per the terms of a bilateral or multilateral air services agreement.¹⁰⁵ Once ICAO SARPs are implemented in domestic regulations, they become binding in that country not only on State-run aviation enterprises, but on the private sector as well. Commercial entities are required to comply with these standards in everything from aircraft manufacturing to flight operation and air traffic management.¹⁰⁶

The ICAO SARPs and COSPAR planetary protection guidelines are similar in some respects—they are both recognized as guides to compliance with a particular treaty provi-

airnavigation/nationalitymarks/annexes_booklet_en.pdf (identifying SARPs adopted by the ICAO Council and annexed to the original treaty).

103. Convention on International Civil Aviation art. 37 Dec. 7, 1944, 61 Stat. 1180, 15 U.N.T.S. 295 (“Each contracting State undertakes to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation. To this end the International Civil Aviation Organization shall adopt and amend from time to time, as may be necessary, international standards and recommended practices . . .”).

104. See I.H.PH. DIEDERIKS-VERSCHOOR & PABLO MENDES DE LEON, AN INTRODUCTION TO AIR LAW 36 (9th ed. 2012) (“Standards have been attributed binding force; this is especially so if national law . . . attaches them, for instance, to their national aviation codes . . .”).

105. *Id.* at 37. For example, the 2001 Open Skies agreement between the United States, Brunei, Chile, New Zealand, and Singapore includes a provision that reads, “[e]ach Party shall, in its relations with the other Parties, act in conformity with the aviation security standards and appropriate recommended practices established by the International Civil Aviation Organization and designated as Annexes to the Convention . . .” Multilateral Agreement on the Liberalization of International Air Transportation art. 7(3), May 1, 2001, T.I.A.S. 13148.

106. See generally 14 C.F.R. §§ 11.83, 34.1, 34.60, 36.1, 36.6, 36.105, 36.106, 61.160, 61.161, 91.703, 91.851, 121.06, 171.59, 171.321 (2020) (promulgating U.S. Federal Aviation Administration (FAA) regulations that frequently reference ICAO SARPs).

sion within a framework convention.¹⁰⁷ However, SARPs may have heightened legitimacy because their creation is expressly referenced in the Chicago Convention. Meanwhile, the COSPAR guidelines have long guided compliance with the Outer Space Treaty, but were not formally recognized for this role by COPUOS until 2017.¹⁰⁸ The text of the SARPs also appears directly in the Chicago Convention's annexes; this close proximity with a legally binding instrument grants the SARPs additional legal character, particularly given that Article 38 of the Chicago Convention creates an "opt out" mechanism whereby States must notify ICAO if their own domestic standards will deviate from the SARPs in any way.¹⁰⁹ Perhaps if the COSPAR guidelines were included as annexes to the Outer Space Treaty they would have heightened visibility and be more quickly adopted in national regulations—though such legalization would be difficult given that COSPAR is an apolitical, scientific body, whereas ICAO is an intergovernmental agency within the United Nations.¹¹⁰ Because Member States send representatives to ICAO to legislate with the interests of all relevant stakeholders in mind, the SARPs are more clearly reflective of international consensus than the planetary protection guidelines resulting from COSPAR's ad hoc processes. While proposed SARPs originate from technical panels similar to those of COSPAR, they must all be approved by the ICAO Council, made up of representatives from Member States.¹¹¹ COSPAR would likely need to enter into a formal partnership with

107. In 2017, the U.N. COPUOS recognized the COSPAR guidelines as a reference standard to guide compliance with the Outer Space Treaty. See Comm. on the Peaceful Uses of Outer Space, Rep. on its Sixtieth Session, ¶ 332, U.N. Doc. A/72/20 (2017) ("The Committee also noted the long-standing role of COSPAR in maintaining the planetary protection policy as a reference standard for spacefaring nations and in guiding compliance with article IX of the Outer Space Treaty.").

108. *Id.*

109. Dempsey, *supra* note 101, at 14.

110. See *About ICAO*, INT'L CIV. AVIATION ORG., <https://www.icao.int/about-icao/History/Pages/default.aspx> (describing ICAO as a specialized U.N. agency, established in 1944 to effectuate the Convention on International Civil Aviation).

111. *Making SARPs: How Does it Work?* INT'L FED'N AIR TRAFFIC CONTROLLERS' ASS'NS, <https://www.ifatca.org/about-ifatca/icao-activities/making-standards-and-recommended-practices-sarps/making-sarps-how-does-it-work/> (last visited Mar. 16, 2021).

COPUOS, perhaps with COPUOS Member States similarly approving its guidelines prior to adoption, before its planetary protection policy could enjoy such elevated status.

An important difference between COSPAR guidelines and SARPs is the nature of the issues they seek to resolve. Aviation standardization is a classic coordination problem in which States agree on the desired outcome—safe and efficient air travel—but require a set of standards to ensure they collectively reach it. Both State-owned aviation enterprises and commercial aviation entities have an interest in successful coordination, since safe air transport is in the public interest and increased efficiency is good for business revenue. Planetary protection is more complicated. When missions to extraterrestrial bodies were exclusively conducted by government agencies, it was possible to agree on the desired outcome: preserving these bodies for future scientific exploration to benefit the public. This presented a mere coordination problem that the COSPAR guidelines could solve. With the advent of private space exploration, however, space actors are interested in something other than public benefit: profit. Since planetary protection requirements raise the costs of conducting space activities,¹¹² it may be difficult to present COSPAR policy as serving the interests of the private sector. Thus, the COSPAR policy is unlikely to be as palatable to the private sector as SARPs.

2. *Codex Alimentarius*

The Codex Alimentarius (Codex) provides another useful analogy to COSPAR guidelines. The Codex is a set of international standards, codes of practice, guidelines, and other recommendations related to food production and food safety.¹¹³

112. See David Bearden & Eric Mahr, Aerospace Corp., Cost of Planetary Protection Implementation, Presentation to the Comm. to Review the Planetary Protection Policy Dev. Processes 2–3 (June 28, 2017), https://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb_180771.pdf (analyzing the costs specified for planetary protection for six missions).

113. See *About Codex Alimentarius*, FOOD & AGRIC. ORG., <http://www.fao.org/fao-who-codexalimentarius/about-codex/en/> (“The Codex Alimentarius international food standards, guidelines and codes of practice contribute to the safety, quality and fairness of this international food trade.”).

In 1961, the U.N. Food and Agriculture Organization established the Codex Alimentarius Commission (CAC), which promulgates the Codex.¹¹⁴ While compliance with the Codex was previously entirely voluntary, the standards were quasi-legalized in 1995 with their incorporation into the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures and the WTO Agreement on Technical Barriers to Trade (SPS/TBT Agreements).¹¹⁵ Though the SPS/TBT Agreements did not make the Codex legally binding *per se*, they tied conformity with the Codex to compliance with WTO agreements and the wider General Agreement on Tariffs and Trade (GATT).¹¹⁶ If a State conforms to the Codex standards, they are presumed to be in compliance with the SPS Agreement and GATT, thus saving the tremendous cost of litigating their compliance with these instruments.¹¹⁷ While Codex standards may still be technically voluntary, failure to implement them in domestic food regulations would result in increased costs to international trade. As a result, States have a strong incentive to comply.

COPUOS's recognition of the important role COSPAR plays in facilitating compliance with the Outer Space Treaty may be the first step toward a similar quasi-legalization of COSPAR's planetary protection policy. However, unlike the WTO with the Codex, COPUOS has not tied non-compliance with COSPAR's policy to any legal consequence. While introducing such consequences would undoubtedly increase adoption of the COSPAR standards in national legislation, it would also impact COSPAR's deliberation process, which may disrupt the ad hoc structure of the organization. The CAC's accountability

114. *Codex Alimentarius: How it All Began*, FOOD & AGRIC. ORG., <http://www.fao.org/3/v7700t/v7700t09.htm>.

115. *Understanding the WTO Agreement on Sanitary and Phytosanitary Measures*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/sps_e/sp-sund_e.htm (last visited Apr. 10, 2021).

116. *See generally* Michael A. Livermore, *Authority and Legitimacy in Global Governance: Deliberation, Institutional Differentiation, and the Codex Alimentarius*, 81 N.Y.U. L. REV. 766 (2006) (discussing the changed role of the Codex Alimentarius after WTO quasi-legalization and proposing a solution for review of the Codex Alimentarius Commission's deliberative process).

117. *See id.* at 775 ("Under SPS Agreement Article 3, domestic food regulations that conform to international standards are presumed to be in compliance with the SPS Agreement and GATT. Members that depart from international standards must be prepared to provide scientific justification.").

and legitimacy has been challenged by stakeholders in the wake of its legalization through the WTO regime, who have raised doubts about the fairness of its deliberation process.¹¹⁸ The Commission is made up of Member States which must approve proposed Codex amendments before they are adopted. Stakeholders have highlighted deficiencies in this process, including inequitable participation among developed versus developing countries and the prioritization of State interests over the interests of non-governmental actors.¹¹⁹ As the CAC illustrates, giving international standards legal consequences changes the nature of the forums promulgating them. Forums become less conducive to the dissemination of scientific knowledge and more favorable to political negotiation, where participants have an incentive to try to align these standards with domestic policy goals.¹²⁰ As COSPAR is a predominantly scientific body without participation by a diverse array of stakeholders, it is not currently equipped to handle the political influence on its deliberative process that would inevitably result from quasi-legalization similar to that of the Codex.

3. *Space Debris Mitigation Guidelines*

Lastly, the COSPAR guidelines may be analogized to a different set of standards within international space law: The Inter-Agency Space Debris Coordination Committee's (IADC) Space Debris Mitigation Guidelines. The IADC first published the guidelines in 2002, and they are intended to facilitate the planning and design of spacecraft and launch vehicles in a way

118. *See, e.g., id.* at 782–86 (“[T]here are deficiencies in the structure of Codex deliberation which have become more problematic in light of the increased authority given to the institution.”).

119. *E.g., id.* (noting the expertise and funds required to participate in and host Codex Committees advantage developed countries and procedural practices favor State interests).

120. *See id.* at 786 (“In addition to drawing attention to existing deficiencies in Codex deliberations, the SPS/TBT Agreement may have actually made deliberation in the Codex less effective. Prior to the Agreements, the Codex served as a forum for the discussion of food policy and the dissemination of scientific knowledge. Now that the Codex serves as the site of negotiation for quasi-binding standards in a unification regime, domestic regulators have an incentive to bring Codex standards more closely in line with domestic policy goals . . .”).

that minimizes the debris generated in Earth orbit.¹²¹ This prevents dangerous collisions between debris and space objects as launch activity increases and orbits become more crowded.¹²² Since their initial publication, the IADC guidelines have been incorporated into space debris mitigation standards issued by both the International Organization for Standardization¹²³ and U.N. COPUOS, which worked to revise them before endorsing its own final version of the Space Debris Mitigation Guidelines in 2007.¹²⁴ Though the guidelines released by COPUOS remain voluntary, elements have been adopted into the domestic law of most spacefaring States.¹²⁵

121. See INTER-AGENCY SPACE DEBRIS COORDINATION COMM., IADC SPACE MITIGATION GUIDELINES 3 (2007), https://www.unoosa.org/documents/pdf/spacelaw/sd/IADC-2002-01-IADC-Space_Debris-Guidelines-Revision1.pdf (“The primary purpose of the IADC is to exchange information on space debris research activities between member space agencies, to facilitate opportunities for co-operation in space debris research, to review the progress of ongoing co-operative activities and to identify debris mitigation options.”).

122. See *id.* at 4 (“[T]he population of debris is growing, and the probability of collisions that could lead to potential damage will consequently increase.”).

123. See H. STOKES ET AL., EVOLUTION OF ISO’S SPACE DEBRIS MITIGATION STANDARDS 1 (2019), <https://www.hou.usra.edu/meetings/orbitaldebris2019/orbital2019paper/pdf/6053.pdf> (“Since 2010 the International Organization for Standardization (ISO) has been publishing a comprehensive set of international standards on space debris mitigation based on guidelines and best practices from the IADC and other bodies.”).

124. See U.N. Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Comm. on the Peaceful Uses of Outer Space, at 1–2 (2010), https://www.unoosa.org/pdf/publications/st_space_49E.pdf (“The Committee on the Peaceful Uses of Outer Space acknowledges the benefit of a set of high-level qualitative guidelines, having wider acceptance among the global space community. The Working Group on Space Debris was therefore established . . . to develop a set of recommended guidelines based on the technical content and the basic definitions of the IADC space debris mitigation guidelines, and taking into consideration the United Nations treaties and principles on outer space.”).

125. See U.N. Office for Outer Space Affairs, Compendium of Space Debris Mitigation Standards Adopted by States and International Organizations, <https://www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html> (last visited Apr. 11, 2021) (identifying national mechanisms for space debris mitigation by country).

These regulations apply to both private companies and government space agencies.¹²⁶

COSPAR could follow in the Space Debris Mitigation Guidelines' footsteps and coordinate more closely with COPUOS on the planetary protection policy. Like the IADC's Mitigation Guidelines, the COSPAR planetary protection policy is endorsed by COPUOS, though COPUOS has not yet incorporated the COSPAR guidelines into its own work. Having the COSPAR guidelines discussed and re-issued by COPUOS would heighten their legitimacy and visibility without compromising their voluntary character. This increased legitimacy may induce States to apply the guidelines through direct regulation of the private space sector, rather than leaving national space agencies to handle planetary protection alone. However, there is a key difference between the IADC and COSPAR guidelines that might impact the latter's ability to emulate the former's process: the regulation of space debris serves private profits because it protects commercial spacecraft from potential damage from stray debris, but planetary protection regulation serves no similar profitable interest for the private sector. Indeed, the same disparity exists between COSPAR policies and the ICAO SARPs. The issue COSPAR seeks to remedy is not a straightforward coordination game. Thus, even if COPUOS were to present the COSPAR guidelines as its own, national governments may still face internal pressure from the private sector to avoid implementing COSPAR policies. Additionally, the IADC is an intergovernmental organization with national space agencies as members, which allows for more political deliberation than a scientific body like COSPAR. IADC's format may provide a stronger "global consensus" to support

126. For example, while NASA has its own debris mitigation procedures, the U.S. Government has adopted Orbital Debris Mitigation Standard Practices that apply to all government agencies, including the FAA which regulates commercial space launches. *See* U.N. Office for Outer Space Affairs, Space Debris Mitigation Standards: United States of America, https://www.unoosa.org/documents/pdf/spacelaw/sd/United_States_of_America.pdf (last visited Apr. 11, 2021) ("The U.S. Government Orbital Debris Mitigation Standard Practices serve as the overall U.S. Government space debris mitigation technical guidance and as the foundation for specific orbital debris mitigation requirements issued by individual U.S. government departments and agencies.").

their guidelines.¹²⁷ The COSPAR PPP has the potential to function more like the IADC, given that half of the PPP's members are scientists appointed by national space agencies. However, the other half of the PPP are scientists unaffiliated with any national agency, and as previously discussed, the level of participation in the panel's decision-making process is often low. These differences must be considered if COSPAR seeks to legitimize its guidelines through COPUOS in the same way as the IADC.

In sum, COSPAR enjoys great respect internationally and has a proven influence on the planetary protection policies of national space agencies. However, some institutional and deliberative redesign may be necessary before its standards achieve the legitimacy or legalization required for States to willingly implement them in private sector regulations.

IV. SHOULD WE RELY ON COSPAR TO SET PLANETARY PROTECTION STANDARDS FOR PRIVATE SPACE EXPLORATION?

This note has highlighted changes to COSPAR's structure and process that may be necessary before the organization can successfully serve as a standard-setting body for private sector planetary protection regulation. An additional question, however, is whether COSPAR *should* be the source of such regulation, or if planetary protection requirements applicable to private space activities should originate elsewhere—say, directly from U.N. COPUOS or from domestic deliberative and regulatory processes. This Part will examine arguments for and against COSPAR's role as the predominant planetary protection standard-setting institution, concluding that it is in the best interest of the international spacefaring community to continue relying on COSPAR.

127. See Joel A. Dennerley, *State Liability for Space Object Collisions: The Proper Interpretation of 'Fault' for the Purposes of International Space Law*, 29 EUR. J. INT'L L. 281, 300 (2018) ("Most space-faring states have contributed to the Mitigation Guidelines by way of membership in the IADC. It could be argued that this is indicative of a 'global consensus' regarding proper conduct in space."); see also 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 112–14 (outlining the consensus-building procedure used by the IADC's Space Mitigation Guidelines that the SSB Committee notes could be a model for COSPAR moving forward).

A. *COSPAR Is a Scientific Body*

COSPAR is, first and foremost, a scientific institution. It “endeavors to ensure that a vibrant international space research effort can be conducted without impediment from geopolitical tensions or differences”¹²⁸ and the guidelines promulgated by the PPP must be “based upon the most current, peer-reviewed scientific knowledge.”¹²⁹ Planetary protection, however, is a multifaceted issue. In addition to scientific concerns, planetary protection has ethical, political, and economic implications that may need to be considered in planetary protection policy.¹³⁰ These other considerations are particularly important for private space actors, whose motivations are different from those of government agencies. For these reasons, an organization focused only on the science of planetary protection in its policy development may be missing part of the bigger picture.

In line with this argument, perhaps a domestic legislature or regulatory agency is better equipped to balance competing concerns and issue planetary protection policies. Legislators can hear from lobbyists, call in experts, and engage in political debate. Further, they are democratically accountable, which grants their policies greater legitimacy than those crafted by an international organization like COSPAR where members participate in an ad hoc decision-making process. Comprised only of scientists (albeit some representing national space agencies), COSPAR may seem less prepared to handle this complex balancing of factors.

128. *COSPAR Statement of Principles*, COSPAR, <https://cosparhq.cnes.fr/about/cospar-statement-of-principles/> (last updated Dec. 2, 2019).

129. *Panel on Planetary Protection (PPP)*, *supra* note 28.

130. Compare Charles S. Cockell, *Planetary Protection—A Microbial Ethics Approach*, 21 *SPACE POL'Y* 287, 288 (2005) (distinguishing an instrumental scientific approach from an ethical approach to planetary protection policymaking and using the latter to consider the intrinsic value of extraterrestrial microorganisms) with Profitiliotis, *supra* note 18, at 599 (applying an environmental economics approach to planetary protection policy that balances the value of extraterrestrial resources with the costs of forward contamination mitigation measures).

B. *International Standards Are Necessary for an International Problem*

Despite concerns regarding COSPAR's ability to respond to the multifaceted concerns of planetary protection, there are significant benefits to an internationally standardized source of planetary protection regulations that apply to *all* space missions, rather than disjointed policies arising from national legislatures. The Outer Space Treaty deems space exploration the "province of all mankind," carried out for "the benefit and in the interests of all countries."¹³¹ Thus, when States permit missions to engage with extraterrestrial bodies, whether government-sponsored or conducted by a private national entity, they must take care to protect these bodies' fragile environments to ensure they remain available for the benefit of other spacefaring nations. However, the tragedy of the outer space commons means that should one nation fail to regulate its private space actors effectively, an entire planetary environment could be compromised for future exploration—for example, if *Beresheet* had carried tardigrades to Mars or one of the icy moons of the outer solar system because of U.S. regulatory oversight, those bodies could have been compromised for future exploration. Outer space is a common resource not subject to appropriation by any nation,¹³² therefore, it would be wise to have a common set of requirements to which all spacefaring nations must adhere.

Common international standards for planetary protection are particularly important considering the process by which international law assigns responsibility for space activities to States. The Outer Space Treaty provides that the State in which a space object is registered retains "jurisdiction and control" over that object while it is in outer space or on a celestial body.¹³³ The Convention on Registration of Objects Launched into Outer Space (Registration Convention) requires that ei-

131. Outer Space Treaty, *supra* note 20, art. I.

132. *See id.* art. II ("Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.").

133. *Id.* art. VIII ("A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body.").

ther the State from whose territory the object is launched or the State who procures the launching (defining either as the “Launching State”) register the space object with the United Nations.¹³⁴ This means that, in most cases, the Launching State has jurisdiction and control over the space object and thus, according to Article VI of the Outer Space Treaty, bears international responsibility for its activities.¹³⁵ Accordingly, it is primarily the Launching State that is responsible for assessing planetary protection compliance for private space missions.¹³⁶ If a privately-sponsored space mission involved a State with low enforcement capacity or a lack of stringent planetary protection regulations in place, then the Launching State could easily overlook violations allowing contamination of an extraterrestrial body. The U.S. may be tightening enforcement of planetary protection requirements, but this will have no effect on missions launched or registered elsewhere. Thus, allowing all Launching States to self-regulate may be inadequate where planetary protection is concerned. While a legally binding convention, rather than voluntary guidelines, would perhaps be the surest way to verify that Launching States have adequate regulations, a set of international standards is at least a better alternative to fragmented national laws.

The international nature of the problem may suggest that relying on COSPAR’s planetary protection policy, even in the private space age, is preferable to leaving this area solely in the hands of domestic political actors. Admittedly, this does not

134. Convention on Registration of Objects Launched into Outer Space art. II, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 (“When a space object is launched into earth orbit or beyond, the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary General of the United Nations of the establishment of such a registry.”).

135. See Outer Space Treaty, *supra* note 20, art. VI (“States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities . . .”).

136. Despite being registered to Israel, it was the United States who conducted a cursory planetary protection review of *Beresheet’s* payload because *Beresheet* was being launched from U.S. territory, thus explaining why both nations can be held internationally responsible for any planetary protection violations caused by the presence of the tardigrades. See Johnson, *supra* note 1 (explaining that the *Beresheet* mission was a national activity of both the United States and Israel, and thus both States are jointly responsible).

overcome the weaknesses in COSPAR's deliberative process. However, it may still be possible to address these issues by ensuring COSPAR deliberations truly reflect international consensus and consider the myriad ethical, political, and economic factors that arise when drafting planetary protection policy. This could be done by forging a closer partnership between COSPAR and COPUOS, perhaps similar to the relationship between the IADC and COPUOS described above. COPUOS is a U.N. committee and thus involves governmental actors equipped for and accustomed to political deliberation. COSPAR and COPUOS have considered such a relationship in the past and concluded it was not appropriate at the time,¹³⁷ but as private space missions increasingly raise planetary protection concerns, the two organizations may need to reconsider. If COSPAR can surmount the challenges posed by its status as a quasi-ad hoc, purely scientific organization, its uniform standards will be preferable to national policies alone.

V. HOW CAN COSPAR'S POLICY ENCOURAGE PLANETARY PROTECTION COMPLIANCE AMONG PRIVATE SPACE ACTORS?

This note has argued that, despite its institutional weaknesses, COSPAR *can* and *should* set standards for planetary protection in the age of private space exploration if its policy deliberation is reformed. As noted above, the SSB Committee has suggested that COSPAR use the IADC's process as a model for international consensus-building.¹³⁸ This Part will briefly present additional solutions that could work in conjunction with such reform in order to encourage compliance with planetary protection requirements by private space actors; namely, legalizing the policy in an international instrument, expanding the PPP's role in monitoring compliance, or incorporating the policy in private sector space contracts.

137. See 2018 REVIEW AND ASSESSMENT, *supra* note 24, at 76 ("The committee understands that COSPAR and COPUOS have discussed this possibility and concluded that it was not appropriate at this time.").

138. See *id.* at 112–14 (discussing how the IADC was formed to facilitate cooperation on space debris research and mitigation).

A. *Legalize the Policy in an International Instrument*

An international instrument would be the most direct way to ensure that spacefaring States enact strong domestic planetary protection regulations, applicable to private actors, based on the COSPAR policy. The COSPAR planetary protection requirements would thus transform from mere guidelines into legal obligations, binding States that accept them. Since planetary protection is one of many issues arising from space exploration, a planetary protection obligation would likely take the form of a singular provision in a larger instrument, as opposed to a treaty all its own. One way to achieve this would be to amend the Outer Space Treaty itself. However, amending the Outer Space Treaty is difficult,¹³⁹ and such legalization could face opposition from States unwilling to bind themselves to standards that were previously always voluntary. Alternatively, a planetary protection provision could feature in a future international instrument—for example, an agreement on the exploitation and use of outer space resources, the creation of which has been discussed often in recent years and was considered during the sixty-second session of COPUOS in 2019.¹⁴⁰ Such a provision could require States to ensure that entities

139. See Outer Space Treaty, *supra* note 20, art. XV (“Any State Party to the Treaty may propose amendments to this Treaty. Amendments shall enter into force for each State Party to the Treaty accepting the amendments upon their acceptance by a majority of the States Parties to the Treaty and thereafter for each remaining State Party to the Treaty on the date of acceptance by it.”).

140. See Comm. on the Peaceful Uses of Outer Space, Rep. on its Sixty-Second Session, ¶ 35, U.N. Doc. A/74/20 (July 3, 2019) (“The view was expressed that the issue of exploitation of the natural resources of celestial bodies called for the establishment of an appropriate international framework within which equitable, sustainable and rational solutions could be found in the future”); *id.* ¶ 257 (“The view was expressed that the purpose of holding consultations and negotiations in the format of a working group should be to develop draft articles of an international treaty that would establish a legally binding, comprehensive international legal framework for the exploration, development and use of space resources.”); see also Comm. on the Peaceful Uses of Outer Space, Legal Subcomm., Proposal for the Establishment of a Working Group for the Development of an International Regime for the Utilization and Exploitation of Space Resources, Working Paper by Belgium and Greece, ¶¶ 13–17, U.N. Doc. A/AC.105/C.2/L.311 (2019) (initiating discussion on the relevant principles of international space law applicable to the development of an international instrument on exploitation and use of outer space resources).

exploring and exploiting resources on extraterrestrial bodies conform to COSPAR planetary protection standards in order to avoid contamination. A similar provision regarding harmful contamination was included in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement), though it more closely mirrors Article IX of the Outer Space Treaty and does not mention the COSPAR guidelines by name.¹⁴¹

However, several problems hinder the codification of COSPAR guidelines in an international instrument. First, of course, is the amount of time any such instrument would take to come into force—treaty negotiation and formation can take years, even decades. Any future agreement on governance of outer space activities is still in the discussion stage. Hundreds of new commercial actors could enter the space exploration industry and many more *Beresheet*-like incidents could occur before the establishment of a new agreement. Second, there may not be the necessary political will for codification. No spacefaring State ratified the Moon Agreement, suggesting that States are not willing to give up autonomy over their outer space activities, nor agree to requirements that could quell the expansion of private industry in space.¹⁴² Finally, codification of COSPAR planetary protection policy would politicize the deliberative process, similar to the way that quasi-incorporation of the Codex Alimentarius into the WTO regime politicized the Commission's process. Since adherence to COSPAR policy would become a legal obligation, States would naturally want to have a larger say in the policy's content. COSPAR, as a quasi-ad hoc scientific organization, is not equipped to handle such politicization without significant institutional reform. For these reasons, while legalization of COSPAR pol-

141. See Agreement Governing the Activities of States on the Moon and Other Celestial Bodies art. 7, Dec. 18, 1979, 1363 U.N.T.S. 3 (“In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise.”).

142. See Michael Listner, *The Moon Treaty: Failed International Law or Waiting in the Shadows?*, SPACE REV. (Oct. 24, 2011) (“The United States, the Russian Federation (former Soviet Union), and the People’s Republic of China have neither signed, acceded, nor ratified the Moon Treaty, which has led to the conclusion that it is a failure from the standpoint of international law.”).

icy in an international instrument might be an effective long-term solution, it is not viable in the short term. Other steps should be taken in the meantime to ensure compliance with planetary protection policies.

B. *Expand the Panel on Planetary Protection's Role in Monitoring Compliance*

In the short term, COSPAR might consider expanding the mandate of the PPP to provide guidelines for implementation and regular monitoring in addition to promulgating the underlying policy. To date, the PPP has not served such a function, leaving monitoring to the national or international authority responsible for compliance with the Outer Space Treaty (which is, in most cases, a State).¹⁴³ COSPAR's objectives state that it aims to facilitate the exchange of information on best practices,¹⁴⁴ but as the landscape of space exploration is complicated by the entry of private actors, it may be time for COSPAR to take a more active role in promoting compliance.

In addition to drafting and amending its policy, a subset of the PPP could periodically review compliance with the planetary protection guidelines internationally and publish its findings. Such review would need to document not only domestic planetary protection policies within national space agencies, but also regulations that apply to private actors. Regulatory gaps, like that in the U.S., could be "named and shamed" in the hopes of incentivizing States to correct these issues swiftly. Collecting domestic planetary protection policies in one place would also provide an easy reference point for legislatures seeking to pass new regulations. Further, the PPP could publish recommended best practices, accounting for the need to

143. See *Panel on Planetary Protection (PPP)*, *supra* note 28 ("It is not the purpose of the Panel to specify the means by which adherence to the COSPAR planetary protection policy is achieved; the best and most cost effective means to adhere to the COSPAR planetary protection requirements is reserved to the engineering judgment of the organization responsible for the planetary mission, subject to certification of compliance with the COSPAR planetary protection requirements by the national or international authority responsible for compliance with the UN Outer Space Treaty.").

144. See *id.* ("[T]he Panel should make every effort, through symposia, workshops, and topical meetings at COSPAR Assemblies, to provide an international forum for the exchange of information on the best practices for adhering to the COSPAR planetary protection requirements.").

promote adherence among both public *and* private space actors, rather than merely serving as a forum for individual representatives to share their practices on a case-by-case basis. These recommendations could resemble the ICAO Guidance Material, which provides advice to States regarding implementation of SARPs and is regularly updated.¹⁴⁵ Neither process would change the voluntary nature of the guidelines: States would still be free to implement them however they see fit. Instead, this new role for the PPP would emphasize the importance of effective implementation, incentivize State action, and minimize the work involved for State governments by suggesting best approaches.

Naturally, this change would require expanding PPP membership to include legal and political experts capable of assessing domestic regulatory processes and formulating sound recommendations. As COSPAR's various panels and commissions are chiefly made up of scientists, this would be a major shift for the organization. However, given the PPP's unique role among COSPAR entities, in that it effectively has a statutory responsibility to guide compliance with Article IX of

145. JIEFANG HUANG, AVIATION SAFETY THROUGH THE RULE OF LAW: ICAO'S MECHANISMS AND PRACTICES 63 (Pablo Mendes de Leon, ed., 2009) ("In addition to SARPs, ICAO has developed abundant guidance material that is published in the form of attachments to ICAO annexes, as ICAO manuals, or in other appropriate forms. Guidance material provides detailed advice to States concerning the implementation of SARPs and is updated progressively."); e.g., ICAO, *Manual of All-Weather Operations*, at 2-2, ICAO Doc. 9365-AN/910 (3d ed. 2013), http://www.caa.md/files/2013_12/543.pdf; ICAO, *Manual of Procedures for Operations Inspection, Certification and Continued Surveillance*, at I-2-1, ICAO Doc. 8335-AN/879 (5th ed. 2010), [https://www.icao.int/APAC/Meetings/2012_FAOSD_Training/Doc%208335%20-%20Manual%20for%20Ops%20Inspection%20Cert%20Continued%20Surv%20Ed%205%20%20\(En\)\[1\].pdf](https://www.icao.int/APAC/Meetings/2012_FAOSD_Training/Doc%208335%20-%20Manual%20for%20Ops%20Inspection%20Cert%20Continued%20Surv%20Ed%205%20%20(En)[1].pdf) ("In order to discharge its responsibility, the State should enact a basic aviation law that will provide for the development and promulgation of air navigation regulations which should be consistent with its acceptance of the Annexes. The State regulatory system should: a) represent a well-balanced allocation of responsibility between the State and the operator for the safety of operations; b) be capable of economic justification within the resources of the State; c) enable the State to maintain continuing regulation and oversight of the activities of the operator without unduly inhibiting the operator's effective direction and control of the organization; and d) result in the cultivation and maintenance of harmonious yet responsible relationships between the State and the operator.").

the Outer Space Treaty,¹⁴⁶ it seems fitting that the PPP deviate from traditional practice and invite different kinds of experts into its membership. So long as the COSPAR guidelines remain recommendations without binding character, including a compliance assessment as part of the PPP's process would not invite excessive political deliberation in the way that formal legalization would.

C. *Incorporate the Policy in Private Sector Space Contracts*

Finally, there may be a contractual solution to regulatory gaps. This solution requires initiative on the part of individual space actors—not States, nor COSPAR itself—to apply COSPAR policies to the private sector. While clear, State-imposed planetary protection regulations are the long-term goal, in the interim, COSPAR-inspired planetary protection provisions can be incorporated into contracts that govern private space activities. NASA's Planetary Protection Independent Review Board (PPIRB) has already recommended that the organization further explore this possibility.¹⁴⁷ This approach recognizes that a space mission is rarely conducted by a single entity. For example, in the *Beresheet* launch, SpaceIL and Israel Aerospace Industries co-developed the lander, SpaceX provided the launch vehicle, and the Arch Mission Foundation sponsored the payload. Contracts necessarily govern each transaction leading up to these collaborative missions, holding each party to certain standards of behavior. Planetary protection requirements could function as one of these standards.

146. See Fisk, *supra* note 89, at 13 (“One issue that troubled me in particular was the Panel on Planetary Protection (PPP), which operated like any other COSPAR panel, but unlike any other panel effectively had statutory responsibilities to determine the international standards for planetary protection to guide compliance with Article IX of the Outer Space Treaty.”).

147. See PPIRB REPORT, *supra* note 19, at 12 (“*Supporting Finding*: Space Act Agreements and some NASA contracts require NASA 8020.12 PP compliance, which in turn invokes COSPAR policy/guidelines. *Supporting Recommendation*: These contractual requirements should be reviewed by NASA to simplify compliance where possible and to avoid overconstraining the means of meeting NASA intent.”); see also Jeff Foust, *Report Calls for Changes in Planetary Protection Policies*, SPACE NEWS (Oct. 19, 2019), <https://spacenews.com/report-calls-for-changes-in-planetary-protection-policies/> (“In the meantime, the report noted NASA can link compliance with planetary protection guidelines with eligibility for NASA contracts.”).

This approach is contrary to the typical top-down method of imposing regulations on private actors, as it relies on these actors to make planetary protection governance choices rather than national legislatures. Nevertheless, such an approach may be advisable for a few reasons. There are high costs associated with regulatory review of the precise contents of every payload, and, as in the Tardigrades Affair, payload sponsors can falsify or conceal material information.¹⁴⁸ Contractual planetary protection provisions would place the onus on the sponsor to accurately represent their payload's contents, rather than shifting the burden to the regulatory body. If a private space actor were to breach a planetary protection provision—whether for reporting of payload contents or any other requirement—found in their contract, the contract would provide a clear means of redress (e.g., litigation). Private sanctioning of the bad actor would decrease the regulatory burden on the public.¹⁴⁹ In a legal landscape increasingly burdened by complex, costly, and cumbersome regulatory regimes, a simple and cost-effective strategy like governance by contract could be the most viable solution.¹⁵⁰

Planetary protection governance by contract could function in two ways. The most obvious is through public-private partnerships, in which a government space agency like NASA or ESA contracts with a commercial actor to conduct a mission. A recent example of this type of partnership is the Commercial Lunar Payload Services (CLPS) initiative, in which NASA contracts with private companies to provide transportation services to the Moon. These missions advance lunar sci-

148. See PPIRB REPORT, *supra* note 19, at 12 (“*Supporting Finding*: it is impractical for launch providers or satellite hosts to definitively determine the biological content of every payload. Biological materials intentionally added by a bad actor are especially challenging for launch providers to monitor or report, as they can be further obscured by falsified verification or inaccurate documentation.”).

149. See *id.* (“*Supporting Recommendation*: Breaches of PP reporting or other requirements should be handled via sanctions that hold the root perpetrator accountable, rather than increasing the verification and regulatory burden on all actors.”).

150. See generally GILLIAN K. HADFIELD, RULES FOR A FLAT WORLD: WHY HUMANS INVENTED LAW AND HOW TO REINVENT IT FOR A COMPLEX GLOBAL ECONOMY (2017) (advocating for a market-based approach to the creation of law that relies on private regulators rather than top-down legislation, incentivizing the formation of simple, efficient legal solutions).

ence, exploration, and commercial development.¹⁵¹ Since NASA already requires that missions conducted with NASA participation are “generally consistent” with COSPAR planetary protection standards,¹⁵² making planetary protection an express provision of a public-private contract is simple. If companies with a demonstrable record of planetary protection compliance are awarded the most lucrative contracts with NASA, private entities will be more likely to adhere to the COSPAR requirements.

Contractual planetary protection provisions are more difficult in space missions with no public involvement, which are conducted only through collaboration of private actors. In private missions, planetary protection provisions could still be incorporated into contracts—however, facilitating inclusion of these terms would be difficult because of high costs of compliance. Private actors are unlikely to voluntarily include planetary protection provisions that would decrease their profit. Certain government incentives, such as tax breaks or subsidies, might be necessary to prompt companies to include planetary protection provisions in the absence of other regulation. Regardless, these possibilities are worth exploring because of their potential as a low-cost, predictable solution to commercial planetary protection compliance in the short-term.

VI. CONCLUSION

It is easy to dismiss the Tardigrades Affair as harmless; the creatures are microscopic, after all, and the moon’s environment stark enough that they do not pose a threat. The Arch Mission Foundation director Nova Spivack’s lax attitude about the event certainly does not suggest cause for alarm; he has cheerfully called himself “the first space pirate,” and refers to the *Beresheet* mission with its tardigrade passengers as “Nova’s Ark.”¹⁵³ But this incident is symbolic of a larger uncertainty regarding how the Outer Space Treaty and its legal framework

151. *Commercial Lunar Payload Services Overview*, NASA, <https://www.nasa.gov/content/commercial-lunar-payload-services-overview> (last updated Feb. 9, 2021).

152. OFFICE OF SAFETY AND MISSION ASSURANCE, NASA, NPR 8020.12D, PLANETARY PROTECTION PROVISIONS FOR ROBOTIC EXTRATERRESTRIAL MISSIONS ch. 2.2.2 (2011).

153. Taylor, *supra* note 8.

apply to private space actors.¹⁵⁴ As commercial interests in space begin to reach beyond Earth orbit, maintaining tight regulation through planetary protection laws is more important than ever. Commercial space activities have astounding potential to enrich humankind through new scientific discoveries, the search for habitable worlds, valuable resource exploitation, and human space travel. However, the law must take care to ensure that fragile extraterrestrial environments are not casualties in a quest to maximize profits.

As the overwhelming source of planetary protection policies in national space agencies, COSPAR remains a vital institution even as the outer space landscape undergoes its public-to-private shift. This note has outlined key areas for organizational development within COSPAR before its standards become as influential in private sector regulation as they have been in public space exploration. Using other international standard-setting bodies as a model and building on its 2017 reform of the PPP, COSPAR can begin its transformation from a quasi-ad hoc, purely scientific institution into one that truly reflects global consensus. COSPAR can invite commercial voices into its planetary protection deliberation process, enhance its monitoring capabilities, and assist spacefaring States by recommending procedures for implementation. The duty to address private space exploration is not solely COSPAR's. In the short-term, governments from whose territories commercial space missions are launched and controlled, like the U.S., should work to close existing regulatory gaps and incentivize space actors to include COSPAR-inspired planetary protection provisions in private contracts. Only collective action can produce an international planetary protection regime equipped to handle rapid privatization of "the province of all mankind."¹⁵⁵ While space piracy might sound glamorous, the global community must take steps to ensure that tardigrades are never again smuggled out to the final frontier.

154. See PPIRB REPORT, *supra* note 19, at 22 ("There is a lack of consensus as to how and when the Outer Space Treaty has legal relevance to non-governmental entities.").

155. Outer Space Treaty, *supra* note 20, art. I.