

CLEANING UP THE MESS: INCENTIVIZING THE SALVAGE OF ORBITAL DEBRIS

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I. INTRODUCTION

On October 4, 1957 at 10:29 PM local time, *Sputnik I*, the first man-made object to orbit the Earth, was launched from Moscow in the Soviet Union¹. The launch, and the accompanying fervor,² sparked the rapid development of technology and exploration, culminating in boot prints on the moon and volumes of information about what lies beyond our planet. Thousands of objects have followed *Sputnik* into orbit, resulting in volumes upon volumes of valuable scientific insight and an increased sense of global connectedness. However, these launches have left behind upwards of 500,000 pieces of debris that continue orbit the earth.³ This debris ranges from ten centimeters in diameter up to the size of used rocket stages and inactive satellites.⁴ Additionally, there are millions of pieces of floating debris that are undetectable and untraceable due to their size.⁵ This floating debris has the potential to cause untold damage to current and future space missions, and each launch must be carefully calculated to account for the immense cloud of debris floating overhead.⁶

The economic and environmental cost presented by abandoned orbital debris could be solved, at least in part, by salvage operations aimed at collecting and utilizing debris for more efficient uses.⁷ Unfortunately, there is no comprehensive orbital salvage law or any international body governing Earth's orbit. There is only general law applying to outer space which focuses primarily on peaceful use and exploration and grants perpetual ownership of orbital objects to their launching states.⁸ The lack of

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¹ *Sputnik and the Dawn of the Space Age*, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, <https://history.nasa.gov/sputnik/>.

² *The Launch of Sputnik, 1957*, UNITED STATES DEPARTMENT OF STATE, <https://2001-2009.state.gov/r/pa/ho/time/lw/103729.htm>.

³ Jesse D. Lively, *Orbital Debris: An Argument in Support of Keeping the Non-Binding Framework*, 42 *Transp. L.J.* 225, 227 (2015); *Space Debris and Human Spacecraft*, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, https://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

⁴ Lively, *supra* note 3, at 227.

⁵ Lively, *supra* note 3, at 227; *Space Debris and Human Spacecraft*, *supra* note 3.

⁶ *Space Debris and Human Spacecraft*, *supra* note 3 (“NASA has a set of long-standing guidelines that are used to assess whether the threat of such a close pass is sufficient to warrant evasive action or other precautions to ensure the safety of the crew[.]”)

⁷ Alexander William Salter, *Space Debris: A Law and Economics Analysis of the Orbital Commons*, 19 *STAN. TECH. L. REV.* 221, 235 (2016).

⁸ G.A. Res. 2222 (XXI) at 14 (Dec. 19, 1966).

salvage law leaves open questions and potential hazards surrounding the growing volume of orbital debris.⁹

An amendment to the current law must be introduced that incentivizes the collection of hazardous orbital debris and minimizes the existing problem. Some point to maritime salvage as a guide for orbital salvage,¹⁰ but that regime's requirement of *voluntariness* and *success* in salvage missions would fail to efficiently manage astrosalvage. These requirements deal specifically with the nature of the sea and are ill-suited for direct application to astrosalvage.

This comment will address the lack of orbital salvage law by recommending an amendment to the existing United Nations ("UN") Rescue and Liability Agreements that adds a good faith component to the applicable maritime salvage principles and applies them with a broad standard of dereliction that takes into account the difference between orbital and maritime debris.¹¹ By adding a good faith component to the elements of voluntariness and success, private and public entities will be incentivized to salvage orbital debris with a diminished risk of loss should the salvage mission fail. A broader definition of dereliction, on the other hand, will do away with perpetual ownership of objects once they are non-operational, incentivizing salvors to collect or repair debris in a timely fashion. These changes will act as a first step toward diminishing the danger to current and future space operations and limiting the environmental impact of orbital debris while also incentivizing investment into salvage.

By way of clarification, the recommended amendments to the UN Rescue and Liability Agreements are not intended to create a comprehensive system of orbital salvage law. Instead, this comment proposes a first step upon which a system of law can develop. The ultimate goal is that space-faring nations will be incentivized to limit their production of orbital debris and will mitigate existing debris while also allowing private investors the opportunity to invest in the potentially profitable industry of orbital debris collection and salvage.

Part II of this paper will discuss the current state of international space law, its purpose and goals, and how it leaves room for salvage without expressly addressing it. Part III will examine maritime salvage law,

⁹ Craig Fishman, *Space Salvage: A Proposed Treaty Amendment to the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space*, 26 VA. J. INT'L L. 965, 978 (1986). ("There is no explicit doctrine of salvage in space because pre-treaty space law was occupied with the development of broad and essential principles primarily aimed at confining the Cold War to this planet.")

¹⁰ N. Jasentuliyana, *Regulation of Space Salvage Operations: Possibilities for the Future*, 22 J. SPACE L. 5, 9 (1994) ("The general concepts of abandonment at sea and the classification of derelict craft, therefore, may provide ideas and analogous situations to assist policy-makers in determining standards and practices for space salvage operations.")

¹¹ See *id.* at 9. Dereliction, or deliberate abandonment, only occurs by an obvious and intentional renunciation of ownership.

including a summary of controlling law and a description of the elements of maritime salvage and how they would be ineffective if applied to astrosalvage. Finally, Part IV will discuss proposed solutions to the orbital debris problem and their various shortcomings, as well as a discussion of the application of good faith and dereliction to orbital salvage.

II. THE CURRENT SYSTEM OF SPACE LAW

Human activity in outer space is primarily governed by five United Nations agreements.¹² The first and most important agreement is the 1967 UN 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”).¹³ The four subsequent agreements, the 1968 UN Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space (“Rescue Agreement”),¹⁴ the 1972 UN Convention on International Liability for Damage Caused by Space Objects (“Liability Agreement”),¹⁵ the 1975 UN Convention on Registration of Objects Launched into Outer Space (“Registration Agreement”),¹⁶ and the 1979 UN Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Treaty),¹⁷ were all developed to support and strengthen the Outer Space Treaty. To that end, each agreement has been successful to a different extent. For the purposes of this comment, only the Outer Space Treaty, Rescue Agreement, Liability Agreement, and Registration Agreement will be discussed

A. *The Outer Space Treaty*

The Outer Space Treaty was promulgated at the height of the Cold War and reflects the intent of the United States and Soviet Union to keep the other from achieving a scientific, military, or territorial advantage.¹⁸ Article II of the agreement states that no nation can make any claim or appropriation of a celestial body “by occupation or any other means.”¹⁹ This has, for the past 50 years, kept outer space and celestial bodies free of sovereign claim despite many manned and unmanned missions throughout

¹² *Space Law Treaties and Principles*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html>.

¹³ See generally G.A. Res. 2222, *supra* note 8, at 13.

¹⁴ G.A. Res. 2345 (XXII) at 5 (Dec. 19, 1967).

¹⁵ G.A. Res. 2777 (XXVI) at 25 (Nov. 29, 1971).

¹⁶ G.A. Res. 3235 (XXIX) at 16 (Nov. 12, 1974).

¹⁷ G.A. Res. 34/68, at 77 (Dec. 5, 1979).

¹⁸ Brandon C. Gruner, *A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century*, 35 SETON HALL L. REV. 299, 317 (2004).

¹⁹ G.A. Res. 2222, *supra* note 8, at 13.

the solar system.²⁰ Additionally, Article IV outlaws the use or placement of weapons of mass destruction in orbit and bans the establishment of military installations on celestial bodies.²¹ Both the United States and the Soviet Union were signatories to the Outer Space Treaty, each limiting their own capability in hopes of future security against the other.²²

The Outer Space Treaty also addresses the fear that technology or personnel launched into space would be captured by other nations. Article V states that astronauts are to be considered “envoys of mankind” and are to be promptly returned to their launching state should they land or crash in foreign territory.²³ Similarly, Article VIII states that all objects launched into space remain the property of their launching state and are to be returned should they land or crash.²⁴ These articles are strengthened by Article XI, which calls for the establishment of national and international registries for objects launched into space to maintain ownership and liability,²⁵ and by the later Rescue, Liability, and Registration agreements.²⁶

There is no provision in the Outer Space Treaty specifically governing the collection or salvage of orbital debris.²⁷ The Outer Space Treaty does, however, address ownership and liability in a way that stalls orbital salvage. Article VIII grants a launching party perpetual ownership of any object it launches,²⁸ and Article VII, using similar logic, dictates that states are liable for any damage caused by objects they have launched.²⁹ Finally, the establishment of national and international registries in Article XI ensure that ownership and liability can be publicly known and enforced.³⁰ Despite intentionally general terminology,³¹ the Outer Space Treaty establishes standards of ownership and liability in a way that discourages the collection of any debris in orbit, abandoned or not. In this

²⁰ See generally, Lynn M. Fountain, *Creating Momentum in Space: Ending the Paralysis Produced by the Common Heritage of Mankind Doctrine*, 35 CONN. L. REV. 1753 (2008).

²¹ G.A. Res. 2222, *supra* note 8, at 14.

²² Fishman, *supra* note 9, at 978.

²³ G.A. Res. 2222, *supra* note 8, at 14.

²⁴ *Id.*

²⁵ *Id.*

²⁶ See Bryon C. Brittingham *Does the World Really Need New Space Law?*, 12 Or. Rev. Int'l L. 31, 40 (2010).

Strict state ownership was expanded and implemented by the International Space Station Agreement, which states that governments maintain ownership in modules they build and launch, and any discoveries become the intellectual property of the state who launched the module. See *id.*

²⁷ Fishman, *supra* note 9, at 978.

²⁸ G.A. Res. 2222, *supra* note 8, at 14.

²⁹ *Id.*

³⁰ *Id.*

³¹ P.J. Blount, *Renovating Space: The Future of International Space Law*, 40 DEV. J. INT'L & POL'Y 515, 524 (2011) ([The Outer Space Treaty] “holds very few hard prescriptive articles, and instead regulates with open language that requires states to communicate in order to avoid conflicts.”)

way, the Outer Space Treaty does not present legal obstacles to any parties that wish to engage in salvage.

The Outer Space Treaty and its establishment of perpetual ownership and liability have had a chilling effect on salvage in two ways.³² First, private or foreign actors are disincentivized to attempt salvage because there is no ownership or rewards granted by collection of debris.³³ While this mirrors maritime law to an extent, perpetual ownership of orbital objects does not allow for abandonment in the same way that maritime law allows for deliberate abandonment and open claim on certain shipwrecks. Second, state actors are unlikely to collect their own debris, regardless of liability, because the costs of collection and maintenance currently outweigh the potential damage debris may cause.³⁴ This leads to a continued crowding of orbital space, creating a “tragedy of the commons” problem, that is, overuse which detrimentally impacts other parties.³⁵ Even if clean-up was effectively encouraged, it is generally difficult to assign liability because much of the existing debris is too small or damaged to be identified to a launching state.³⁶

Despite the lack of developed salvage law, the Outer Space Treaty provides a basis on which all other space law has been built, and the Outer Space Treaty has served its intended purposes – the prevention of proprietary claims and military installations – quite well. While broad, it allows signatory states to have a level of security in their own development and exploration of space without the risk of rival powers making claims, capturing astronauts or spacecraft, or placing weapons in space.³⁷ This security, however, came at the price of limiting future claims or new appropriation of land or chattel. Nonetheless, the Outer Space Treaty provides a nexus that has been expanded and strengthened by subsequent agreements which, while enforcing the articles of the Outer Space Treaty more comprehensively, further limited the discussion of orbital salvage.

B. *The Rescue Agreement*

The Rescue Agreement significantly expanded upon the powers of Articles V and VIII of the Outer Space Treaty.³⁸ The Rescue Agreement requires states to notify launching parties of the crashed personnel and craft, and to provide necessary aid to return them to their home country.³⁹ It also required signatory states to render all possible assistance to all crashed craft

³² See generally *id.*

³³ See generally, G.A. Res. 2222, *supra* note 8, at 14.

³⁴ *Id.*

³⁵ Salter, *supra* note 7, at 228 (citing generally Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968)).

³⁶ Jasentuliyana, *supra* note 10, at 11.

³⁷ See generally, G.A. Res. 2222, *supra* note 8, at 14.

³⁸ See generally, G.A. Res. 2345, *supra* note 14.

³⁹ *Id.* at 6.

and personnel, regardless of national origin.⁴⁰ The Rescue Agreement affirms the ownership of member states over their craft and personnel established in Articles V and VIII of the Outer Space Treaty.⁴¹

Article I of the Rescue Agreement requires signatory states to inform the launching party of a craft of the discovery of personnel or spacecraft of that state.⁴² Signatory states are required to do so publicly and by “all appropriate means.”⁴³ Article IV then requires signatory states to return crashed personnel and spacecraft to their launching states.⁴⁴ In one regard, Articles I and IV of the Rescue Agreement help states maintain control over their own personnel and space craft.⁴⁵ In another, these articles serve the Outer Space Treaty’s overarching goal of keeping space a neutral territory.⁴⁶ Both features solidify and confirm the exclusive ownership that states have in their own craft and limit the ability of salvors to benefit from or collect orbital debris.

Articles II and III require states to render assistance in the event of a crash within their own territory or in international waters, respectively.⁴⁷ This could serve several purposes, but it primarily stops states from withholding aid from astronauts or spacecraft based on national origin. It also stops states from making claims to objects simply because they crash within national borders. Presumably, Articles II and III also have the added benefit of balancing the interests of launching states and those required to render assistance, incentivizing states to assist in recovery absent the possibility of benefit.

The Rescue Agreement grants confirmation and support to the perpetual ownership states have in their craft without granting salvors any specific rights.⁴⁸ No claim can be placed on an object based on where it crashes,⁴⁹ and all personnel and craft must be returned to home states as quickly as possible.⁵⁰ Further, states are required to expend all appropriate effort in notifying the launching state and in rescuing crashed objects and astronauts.⁵¹ While orbital debris and salvage are not specifically mentioned, the Rescue Agreement grants support to ownership rights granted by the Outer Space Treaty by stopping other states from making claims to fallen craft.

⁴⁰ *Id.*

⁴¹ *Id.*

⁴² *Id.*

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ Gruner, *supra* note 18, at 299.

⁴⁷ G.A. Res. 2345, *supra* note 14, at 6.

⁴⁸ See G.A. Res. 2345, *supra* note 14, at 6.

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ *Id.*

C. *The Liability Agreement*

While the Rescue Agreement gives support to state ownership, the Liability Agreement reinforces the responsibility states have for any damage done by craft or debris they own.⁵² This includes damage done in orbit, on the surface of the earth, or on other celestial bodies.⁵³ The Liability Agreement overlaps with the Rescue Agreement in that both agreements dictate that all crashed material is to be returned to the launching state.⁵⁴ The Liability Agreement then departs, enforcing liability and outlining how damages and indemnification are to be collected.⁵⁵

The Liability Agreement begins by dictating that states are liable for any damage or loss of life resulting from any stage of launch, spaceflight, or landing.⁵⁶ All damages are to be collected through diplomatic channels.⁵⁷ States share joint and severable liability in cases of cooperative launches,⁵⁸ and jointly liable states are allowed indemnification from other states involved.⁵⁹ However, damages and indemnification between co-liable states can only be collected where the damage is clearly caused by the launching state.⁶⁰

However, proving liability can be difficult because the condition or size of fallen objects often makes them unidentifiable as to their state of origin.⁶¹ After all, liability cannot be enforced when most damage-causing debris cannot be tied to a particular state. This requirement of clear proof of liability, therefore, indicates the growing need for astrosalvage. States can only be held liable for damage that has been caused by a craft with clear ties to the launching state.⁶² Additionally, states are barred from collecting any debris when the state of origin is unclear. A system of dereliction and salvage would help resolve this issue and mitigate the problem of danger debris, regardless of identifiability.

D. *The Registration Agreement*

The Registration Agreement has sought to strengthen the Outer Space Treaty, Rescue Agreement and Liability Agreement by requiring states to list launched objects within registries overseen by the UN.⁶³ The registration includes information about an object's design and markings as

⁵² G.A. Res. 2777, *supra* note 15, at 25.

⁵³ *Id.*

⁵⁴ G.A. Res. 2345, *supra* note 14, at 6. *See also*, G.A. Res. 2777, *supra* note 15, at 26.

⁵⁵ G.A. Res. 2777, *supra* note 15, at 25.

⁵⁶ *Id.*

⁵⁷ *Id.* at 26.

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ *Id.* at 25.

⁶¹ Jasentuliyana, *supra* note 10, at 11.

⁶² G.A. Res. 2777, *supra* note 15, at 26.

⁶³ G.A. Res. 3235, *supra* note 16, at 16-17.

well as its proposed path and mission.⁶⁴ The registered information is meant to help identify launched objects to their nation of origin and supports the perpetual ownership of objects in space by keeping other states apprised of who owns what.⁶⁵

This system, however, will never be able to catalog all the debris in orbit. It is unlikely that the drafters of the Registration Agreement foresaw the buildup of orbital debris, especially the 5 million or more pieces of debris that cannot be tracked adequately because of their size.⁶⁶ Pieces of orbital debris, large or small, still legally belong to their launching states under the Outer Space Treaty,⁶⁷ but there is no way to effectively identify them. This expands ever-increasing volume of material in orbit that presents a serious hazard, but will never be claimed unless amendments are made to the Rescue and Liability agreements that allow salvors to collect orbital debris.

The Outer Space Treaty, as well as the Rescue, Liability, and Registration Agreements have sought to preserve the rights of launching states while limiting the possibility of rival nations establishing proprietary or hostile occupation of space. To that end, space law is well structured, generally applying to space while outlining specific rights and responsibilities. However, the way humanity interacts with outer space is changing. Concerns about national security and hostile claims in space still exist, but there has also been an enormous private investment into space launches and use over the past decade.⁶⁸ While private space flight has historically occupied a very small area of the market, there were over 30 private space launches planned in 2016 alone,⁶⁹ which only represents the activity of two firms launching from one site.⁷⁰ Increased private investment raises new issues that were not anticipated by the existing UN agreements. Nations and private actors will presumably be forced to examine other sources of law for any number of new space-related questions as our reach extends further beyond earth's atmosphere.

III. MARITIME SALVAGE LAW

On its face, it seems reasonable to borrow heavily from maritime salvage law to define an astrosalvage regime. Both outer space and the deep sea are widespread, inaccessible without technological assistance, and

⁶⁴ *Id.* at 17.

⁶⁵ Jasentuliyana, *supra* note 10, at 11

⁶⁶ *Id.*

⁶⁷ G.A. Res. 2222, *supra* note 8, at 14.

⁶⁸ See generally, Joseph Stromberg, *Private Spaceflight, explained*, VOX (Sept. 4, 2015) <https://www.vox.com/2015/2/6/18073658/private-space-flight>.

⁶⁹ *U.S. Private Space Companies Plan Surge in Launches This Year*, REUTERS (Jan. 1, 2018), <http://www.reuters.com/article/us-space-launches/u-s-private-space-companies-plan-surge-in-launches-this-year-idUSKCN0VC2G7>

⁷⁰ *Id.*

difficult to subject to proprietary claim.⁷¹ There is also a wealth of history behind maritime salvage law that could educate the development of orbital salvage law. For nearly as long as mankind has been sailing the seas, nations have been developing common and statutory law to deal with salvage disputes.⁷² This historical background has shaped modern salvage law wherein most coastal countries use similar models with only small differences between nations.⁷³ Modern maritime salvage law is governed primarily by the 1989 International Convention on Salvage⁷⁴ which draws heavily from the historical law of UN member states.⁷⁵ Notably, while many developed nations are party to the International Convention on Salvage, large seafaring nations such as the United States and China have not officially signed the Convention,⁷⁶ opting instead to establish domestic law and smaller agreements between themselves governing the open ocean and seabed in a way better suited to their economic needs.⁷⁷

This section provides a brief history and the current state of international salvage law and presents general principles that run throughout salvage law. This section will demonstrate how maritime law could be used as a template for orbital salvage law while also indicating that direct application of maritime salvage law to orbit would be problematic.

A. *Historical Common Law Salvage*

The Marine Ordinance of Trani (1063 A.D.) was the first maritime statute to be formally recorded and promulgated.⁷⁸ It awarded the “finder with half the goods found floating at sea if the owner appeared” and granted full ownership to the finder “if at the end of thirty days the owner [did] not appear.”⁷⁹ This idea of salvage changed very little until the 13th century when the Laws of Oleron were established in Britain as a precursor to formal English salvage law based on common law.⁸⁰ From that point,

⁷¹ Brittingham, *supra* note 26, at 49.

⁷² Olivia Lennox-King, *Laying the Mark to Port and Starboard: Salvage under Duress and Economic Duress at Contract Law*, 21 AUSTL. & N.Z. MAR. L.J. 32, 34 (2007). *See also*, Marc E. Montgomery, *Navigating the Back Channels of Salvage Law: Procedural Options for a Small Boat Salvor*, 83 TUL. L. REV. 1463, 1465 (2009).

⁷³ *Id.* at 35.

⁷⁴ *Id.*; *See also*, International Convention on Salvage, art. 2, 13, Apr. 28, 1989, 1953 U.N.T.S. 33479.

⁷⁵ While other law governing practices at sea exist, such as the United Nations Conventions on the Law of the Sea (“UNCLOS”), these agreements leave the issue of salvage to existing international and domestic law. *See generally* Ricky J. Lee, *Reconciling International Space Law with the Commercial Realities of the Twenty-First Century*, 4 SING. J. INT'L & COMP. L. 194, 226, 242 (2000).

⁷⁶ Salter, *supra* note 7, at 235.

⁷⁷ *Id.*

⁷⁸ Lawrence J. Lipka, *Abandoned Property at Sea: Who Owns the Salvage "Finds"?*, 12 WM. & MARY L. REV. 97, 97-98 (1970), available at <http://scholarship.law.wm.edu/wmlr/vol12/iss1/7>.

⁷⁹ *Id.* at 98.

⁸⁰ *Id.*

English salvage law focused primarily on “ownership by possession,⁸¹” only developing different types of claims by later statutes.

Today, via additional statutes and developments in case law, most countries conform to traditional salvage claims. Unidentified and unclaimed goods washed up on shore generally belong to the government, while anything lost at sea belongs to its original owner who may contract for salvage or conduct independent collection.⁸² The notable exception to this rule is that coastal states have claim on any unclaimed shipwreck on the seabed between their coastal boundary and the continental shelf.⁸³ It is in the spaces between these coastal and continental boundaries where questions persist about ownership of lost goods.

B. *International Convention on Salvage*

The International Convention on Salvage (“Salvage Convention”) was debated and established in the United Kingdom in 1989, updating the previous Brussels Convention on Assistance and Salvage at Sea (“Brussels Agreement”).⁸⁴ The Salvage Convention states that all salvors owe a duty to owners of craft or equipment lost at sea,⁸⁵ and delves deeply into when rewards are owed to a salvaging party⁸⁶ and by what terms and considerations parties can enter into salvage contracts.⁸⁷ Notwithstanding historic common law and domestic salvage law unique to each nation, the Salvage Agreement is the primary source of international salvage law.⁸⁸

The Salvage Agreement begins by stating that it was established to bridge the historical gap between the Brussels Agreement of 1910 and today.⁸⁹ As such, the drafters spend much of the text defining the nature of negotiations involved in salvage to account for modern trade and technology.⁹⁰ Articles V through VII deal specifically with the powers given to private and public operators as they negotiate salvage contracts.⁹¹ Article VIII of the Salvage Agreement states that salvaging parties owe a duty to owners of sunken objects to practice due care during salvage operations to minimize damage and costs, and to seek assistance when necessary to keep damage operational costs low.⁹² In return, salvees must cooperate with

⁸¹ *Id.*

⁸² *See generally, id.*

⁸³ *See* United Nations Convention on the Law of The Sea, Annex II art. 1-9. *See also* Elizabeth Barrowman, *The Recovery of Shipwrecks in International Waters: A Multilateral Solution*, 8 Michigan J. Int'l L. 231, 235 (1987).

⁸⁴ *See generally* International Convention on Salvage, *supra* note 76, at 3.

⁸⁵ *Id.* at 4.

⁸⁶ *Id.* at 5-6.

⁸⁷ *Id.* at 4.

⁸⁸ *See generally id.*

⁸⁹ International Convention on Salvage, *supra* note 76, at 3.

⁹⁰ *Id.*

⁹¹ *Id.* at 4.

⁹² *Id.* at 4-5.

salvage operations and accept delivery of salvaged goods.⁹³ Article VIII serves the interest of the party that owns the object by limiting damage and costs associated with collection, but also ensures salvors that their efforts will not go unrewarded.⁹⁴ Article VIII also defends against salvors who may deliberately commit to costly salvage operations without seeking assistance in hopes of hoarding the reward.⁹⁵

The Salvage Agreement continues by outlining how rewards of salvage are established and calculated.⁹⁶ Article XII provides ten criteria by which the size of a reward is decided, including the value of the salvaged property, the measure of success of the salvor, and the operating costs incurred by salvors while completing the operation.⁹⁷ Presumably, by providing a concrete list of considerations, the costs incurred in negotiating a contract are limited, and both parties better understand the costs and benefits of a salvage operation.

The remainder of the Salvage Agreements deals first with distribution of awards among salvors and claims that may be placed on salvaged objects by maritime lien or other devices, and continues through the means of ratification, entry into force, and amendment processes.⁹⁸ Taken together, the Salvage Agreement provides a comprehensive regime on maritime salvage.

C. General Principles

Certain general principles of salvage can be gleaned from the existing law. First, property rights of states and private owners are perpetual in sunken objects. This protects them from adverse claims and prevents a “finders-keepers” approach to salvage. Such an approach is only allowed in cases of dereliction where an owner intentionally abandons ownership rights. Additionally, the existing body of salvage law provides three requirements for a salvor to collect the reward of a salvage operation. While these principles present a template upon which orbital salvage can be based, they need to be adapted to fit the needs of orbital operations.

i. Property Rights are Perpetual in Sunken Objects

Property rights remain with the original owner of sunken craft forever, allowing for a collection or salvage of material at any time.⁹⁹ This stops salvors from staking claims on anything they pull up. Instead salvors are granted rewards for services rendered, as defined either by a salvage

⁹³ *Id.*

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ *Id.* at 5-6.

⁹⁷ *Id.* at 5

⁹⁸ *Id.* at 6-10 (art. 14-33).

⁹⁹ Jasentuliyana, *supra* note 10, at 18.

contract or by international law.¹⁰⁰ Granting perpetual ownership removes the risk that a vessel would be taken before the owner had a chance to collect or contract for salvage.

Perpetual ownership is akin to Article VIII of the Outer Space Treaty, as well as the Liability and Rescue Agreements, stating that any object launched into space remains the property and responsibility of the launching state.¹⁰¹ It serves a similar purpose in both areas of law, keeping rival nations from claiming another craft for their own purposes. However, perpetual ownership rights do not serve the same purpose in space as they do at sea. As will be discussed more deeply below, perpetual ownership does not necessarily serve the economic interests of nations and private actors or eliminate the environmental hazard created by orbital debris. Additionally, perpetual ownership may be redundant in space as adverse claims are more difficult and expensive to make than on the ocean floor.

ii. Elements of Maritime Salvage

There are three prerequisites for a salvor to be able to collect a reward for a salvage operation.¹⁰² First, the object must be in actual peril.¹⁰³ Simply put, it must be in a situation that requires salvage and where the craft cannot be saved without additional assistance.¹⁰⁴ The second prerequisite is that the salvage act must be voluntary for both the salvor and the salve.¹⁰⁵ This allows owners to control who conducts salvage missions and for how much. The voluntariness requirement also has the added effect of stopping those with a preexisting duty to a vessel, such as crew members, from conducting salvage for a reward.¹⁰⁶ Finally, salvors must be “successful or [at least] partially successful in saving . . . at least a part of the property at risk[.]” to claim a reward.¹⁰⁷ Only if all three prerequisites are fulfilled can a salvor collect for services rendered.¹⁰⁸

iii. Dereliction

Unlike space law, maritime law allows for an object to become derelict, or abandoned for anyone to collect.¹⁰⁹ Such situations are governed

¹⁰⁰ Jasentuliyana, *supra* note 10, at 18.

¹⁰¹ G.A. Res. 2222, *supra* note 8, at 14.

¹⁰² Fishman, *supra* note 9, at 979.

¹⁰³ *Id.*

¹⁰⁴ *Id.*

¹⁰⁵ *Id.* at 979-80.

¹⁰⁶ *Id.*

¹⁰⁷ *Id.* at 980.

¹⁰⁸ *Id.* at 979.

¹⁰⁹ Jasentuliyana, *supra* note 10, at 16.

by the law of finds¹¹⁰ and, if challenged, the courts must decide whether a sunken object was indeed abandoned.

The law of finds and international law define dereliction in multiple parts.¹¹¹ First, the object must be abandoned by the owners without hope of recovery (*sine spe recuperandi*).¹¹² This puts a definitive end on the claim of the original owner. Second, it must be considered abandoned property (*res derelictae*), to which the law of finds applies instead of the law of salvage.¹¹³ Under the law of finds, the subsequent finder establishes an ownership right superior to all but the original owner.¹¹⁴ Additionally, the object must be abandoned in international waters.¹¹⁵ Any object abandoned within a state's territory or coastal boundaries becomes the property of that state.¹¹⁶ Once an item becomes derelict, it is considered ownerless, and any party with the ability to claim it may do so.¹¹⁷ Dereliction allows for the removal of dangerous obstacles while simultaneously allowing sunken objects to have economic benefits via collection and use.

Maritime salvage law has been crafted over the centuries into a system specifically designed to efficiently manage the collection of lost goods and vessels, as well as the reimbursement of owners and salvors who expend the effort to collect them.¹¹⁸ As such, ownership rights are enforced effectively and fairly. This historical model, with all its elements of collection and dereliction, could be applied to orbit with relatively little adjustment, making orbital salvage as economically viable and accessible as maritime salvage.

IV. ECONOMIC IMPACT OF ORBITAL DEBRIS

The lack of effective astrosalvage law creates a net loss for the global community. Millions of dollars are invested into each orbital mission and, due to mission failure, planned jettison, or lack of maintenance, objects of varying size are left non-operational in orbit.¹¹⁹ These objects,

¹¹⁰ The law of finds is essentially a system of "finders' keepers" in which the one who finds and makes a constructive claim on the object possesses property rights superior to everyone but the original owner. See Fishman, *supra* note 9, at 979. James A. R. Nafziger, *Finding the Titanic: Beginning an International Salvage of Derelict Law at Sea*, 12 COLUM.-VLA J.L. & ARTS 339, 343-44 (1987).

¹¹¹ See Jasentuliyana, *supra* note 10, at 16.

¹¹² *Id.*

¹¹³ Nafziger, *supra* note 112, at 343.

¹¹⁴ See *id.* at 343-44.

¹¹⁵ Jasentuliyana, *supra* note 10, at 16.

¹¹⁶ See *id.*

¹¹⁷ *Id.* (citing WILLIAM RANN KENNEDY, SIR, ET AL., *KENNEDY'S LAW OF SALVAGE* 85-86 (5th ed. 1985)).

¹¹⁸ See *International Convention on Salvage*, IMO, <http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Salvage.aspx> (last visited Feb. 28, 2019).

¹¹⁹ Lively, *supra* note 3, at 227.

representing millions of dollars in research and development, are often left unclaimed, creating safety and environmental hazards.¹²⁰ This tragedy of the orbital commons and crowding of orbital space continues because states are not required to collect or repair their orbital craft or debris. Additionally, states maintain perpetual ownership of objects they launch, which removes any incentive they might have to remove their debris. This lack of action indicates that states consider maintenance and collection costs for orbital debris to be higher than the potential cost of liability.

A change in the astrosalvage law would incentivize private actors to participate in salvage operations.¹²¹ Further, this shift would incentivize states to minimize their orbital debris by collecting debris within a defined period or performing maintenance on the same.¹²²

A. *The Losses of Current Astro Salvage Policy*

Outer space and orbit are enormous common areas potentially presenting a public good to humanity. No one person or state controls access to space, and similarly, no one can limit the use of outer space resources or the are inhabited by orbital objects.¹²³ In one sense, this is positive. As a public good, space presents the opportunity for different states to cooperate in exploration and scientific investigation.¹²⁴ In this light, outer space can be considered the “common heritage of mankind,”¹²⁵ and used for the common benefit and advancement of humanity without the establishment of proprietary claims.¹²⁶ However, the current space law regime creates a situation in which states and actors who have the actual ability to reach space will likely reject international arrangements that do not favor of their own interests, leading to overuse.¹²⁷

A similar problem of overuse has developed in orbit. Since states have perpetual ownership of objects they launch and lack the incentive to minimize or remedy their clutter, a tragedy of the commons problem has arisen.¹²⁸ In *The Tragedy of the Commons*, Garrett Hardin describes a

¹²⁰ Salter, *supra* note 7, at 228.

¹²¹ *Id.* at 236. (“A more involved response would have private firms bidding on contracts for removal or destruction of debris.”).

¹²² *Id.* at 232. (“To summarize thus far, the space debris problem exists because of externalities that some spacefaring agents impose on others and because of the tragedy of the commons. At the general level, the most reliable solution to such problems is the establishment and enforcement of private property rights.”).

¹²³ *See id.* at 228.

¹²⁴ *Id.* at 227.

¹²⁵ Barbara Ellen Heim, *Exploring the Last Frontiers for Mineral Resource: A Comparison of International Law Regarding the Deep Seabed, Outer Space, and Antarctica*, 23 VAND. J. TRANSNAT'L L. 819, 827 (1990) (listing the elements of the Common Heritage of Mankind doctrine.)

¹²⁶ *Id.* (citing Grier C. Raclin, *From Ice to Ether: The Adoption of a Regime to Govern Resource Exploitation in Outer Space*, 7 NW. J. INT'L L. & BUS. 727, 739 (1986)).

¹²⁷ The United States has created agreements with other industrialized nations to create a rival legal regime to the UN Law of the Sea Convention. *See generally id.* at 829.

¹²⁸ Salter, *supra* note 7, at 228.

situation in which all parties try to reap the greatest benefit from a given resource, but harm one another through the additional consumption of a depleted public good.¹²⁹ Applied to orbit, this means that the individual cost to states of minimizing or collecting orbital debris is too great given that no additional cost is incurred by leaving it in orbit.¹³⁰

The problem is two-fold. First, every piece of additional orbital debris makes every subsequent launch more hazardous and expensive to complete.¹³¹ It can be assumed that this increasing cost directly incurred by other space actors will eventually become too costly or dangerous to achieve.¹³² Second, there is the matter of waste. Each object launched into space is made of valuable material that, when inoperable, is wasted as it orbits the earth unutilized.¹³³ This material, which could be sold as scrap, studied for scientific investigation, or sold to collectors, presents no benefit as debris.¹³⁴ This, of course, relies on the assumption that there is a market for orbital debris, but even when sold at a low price, the sheer volume of orbital debris presents enormous value.¹³⁵ Further, as stated above, if it is left to collect, waste would build on itself and the net loss will continue to grow. The law fails to address these issues. There must be a change focused on maximizing the benefits of the debris floating overhead.

B. *Potential Economic Gains from Astrosalvage*

There are multiple benefits to be gained from allowing salvors to access orbit to salvage. The scrap metal in orbital debris represents an estimated millions, if not billions, of dollars in value that is not being claimed, potentially offsetting the massive cost to collect it.¹³⁶ These materials could be repurposed, sold to collectors, or used as scrap. As an example, salvage could present the opportunity to minimize the net weight of craft leaving the planet subject to the amount of scrap that could be collected and utilized for construction of tools and instruments or potential manufacturing and mining efforts on celestial bodies.¹³⁷ It has even been suggested that the remains of what has already been launched into space

¹²⁹ See generally Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1234, 1244 (1968) available at <http://science.sciencemag.org/content/162/3859/1243.full>. s

¹³⁰ Salter, *supra* note 7, at 228.

¹³¹ See *id.*

¹³² JOINT AND COALITION OPERATIONAL ANALYSIS (JCOA), MULTINATIONAL EXPERIMENT 7, ACCESS TO GLOBAL COMMONS: PROTECTING ACCESS TO SPACE (July 8, 2013), <https://www.hsdl.org/?view&did=754742>.

¹³³ *Id.*; see also Salter, *supra* note 7, at 233.

¹³⁴ Salter, *supra* note 7, at 233.

¹³⁵ *Id.* at 233-34.

¹³⁶ *Id.* at 233 (“A major difficulty lies in the realization that much debris is valuable scrap material that is already in orbit.”).

¹³⁷ See *id.* at 233-34.

could be collected and repurposed to build a new space station or lunar facility.¹³⁸

The gains from salvage law are not limited to monetary or scientific application. There is also a significant environmental gain from allowing the salvage of orbital materials.¹³⁹ It is estimated that, assuming a limited creation of new orbital debris, the level of dangerous debris in orbit can be stabilized within the next century with the removal of just five large pieces of debris per year.¹⁴⁰ This, in turn, would help to minimize collisions in orbit and limit the risk of debris falling into populated areas, as was anticipated by the Outer Space Treaty and the Liability Agreement.¹⁴¹ This approach would make strides toward solving the tragedy of the commons problem while granting a general economic incentive and financial boost from the utilization of orbital material.

The global market would benefit from increased incentives and lowered barriers of access to salvage operations in a couple of ways. First, allowing for property rights in orbital objects to lapse would incentivize states to either collect their debris or lose it to salvors. This increased opportunity could incentivize salvors to make the investment to collect orbital debris to benefit from the new opportunities. While the cost of such an endeavor would be expensive, the benefits available from salvaging contracts with states, the historical and cultural heritage tied up in many pieces of orbital debris, and the face value and sheer volume of orbital objects could potentially offset the costs. This new market has the potential to result in better launch and collection practices and allow for a more efficient use of orbital debris. There are many benefits to be reaped from astrosalvage, provided that the global community were to amend the current law to allow for the collection and use of material.

None of this is to say that changing the legal regime surrounding orbital salvage would make for a quick benefit to individual salvors, states, or the global community. Space travel, even that which never leaves orbit, is prohibitively expensive, which serves as a barrier to entry for many would-be salvors.¹⁴² However, these barriers are significantly higher when one considers the fact that there is currently no incentive or motivation for states or private firms to develop the affordable means and technology to collect valuable orbital debris.

¹³⁸ Megan Garber, *The Trash We've Left on the Moon*, THE ATLANTIC (Dec. 19, 2012), <https://www.theatlantic.com/technology/archive/2012/12/the-trash-weve-left-on-the-moon/266465/>.

¹³⁹ Jer-Chyi Liou, et al., *Controlling the Growth of Future LEO Debris Populations with Active Debris Removal*, 66 ACTA ASTRONAUTICA 648, 648 (2010).

¹⁴⁰ Salter, *supra* note 7, at 235 (citing Liou, *supra* note 142, at 648).

¹⁴¹ G.A. Res. 2222, *supra* note 8, at 14 ; G.A. Res. 2777, *supra* note 16, at 16.

¹⁴² See Andre Radensky, *'The Force Awakens' for Commercial Space Flight and Space Tourism*, BUS. TODAY (Mar. 23, 2018), <http://journal.businesstoday.org/bt-online/2018/the-force-awakens-for-commercial-space-flight-and-space-tourism>.

One might argue that the salvage debate is moot until countries develop the necessary plans and technology to collect orbital debris, but this fails to recognize that the way must be opened for salvors to access profitable debris before they will invest the time and capital necessary to conduct salvage. Additionally, many countries who possess the ability to access orbit and outer space also possess the capability to track, access, and move orbital debris to less hazardous orbital locations. It is not hard to imagine that this same technology could be integrated into the collection of orbital debris, shifting focus back to the changes which must be made to the existing legal regime to bring commercial salvage within reach.

V. PROPOSED SOLUTIONS FOR ASTROSALVAGE LAW

As national space programs and private companies discuss and plan new and exciting space missions, the issues that plague the current regime of space and orbital law have come to the forefront of aerospace discussions. Much of the discourse, however, has been focused on the establishment of proprietary ownership of land on celestial bodies such as the Moon and Mars.¹⁴³ Aside from the fact that the Outer Space Treaty and successive treaties have made such claims legally problematic,¹⁴⁴ the discussion has also been virtually devoid of discourse about orbital salvage, resulting in a lack of legal and scholarly material aimed at addressing orbital debris.

There seems to be an impasse of conflicting capabilities and intentions. Those in the best position to deal with the environmental and safety hazards of orbital debris have not been sufficiently incentivized to minimize the creation of debris,¹⁴⁵ and those in a position to benefit economically from the collection, repurposing, and sale of orbital debris have been blocked by the existing law that disincentivizes the use of space for fear of loss.¹⁴⁶ To address the problem, some have suggested applying maritime salvage law directly to orbit.¹⁴⁷ However, there are key differences between orbital and oceanic salvage that make direct application

¹⁴³ See generally David Collins, *Efficient Allocation of Real Property on the Planet Mars*, 14 B.U. J. SCI. & TECH. L. 201 (2008); Glenn Harlan Reynolds, *Staking a Claim*, 190 POPULAR MECHANICS 50 (2013); Rachel Riederer, *Whose Moon Is It Anyway?* 61 DISSENT 6 (2014); Sarah Jane Fox, *SPACE: The Race for Mineral Rights 'The Sky is No Longer the Limit' Lessons From Earth!*, 49 RESOURCES POL'Y 165 (2016).

¹⁴⁴ Collins, *supra* note 117, at 208 ("The uncertain legal framework of the existing treaty regime would undermine optimal investment since there would be fear of uncompensated expropriation under the auspices of the UN or some other international organization favoring absolute common ownership of all extra-planetary resources.").

¹⁴⁵ Salter, *supra* note 7, at 227-28.

¹⁴⁶ Adam G. Quinn, *The New Age of Space Law: The Outer Space Treaty and the Weaponization of Space*, 17 MINN. J. INT'L L. 475, 488 (2008) (describing how the common heritage and common domain interpretations of international law have led to an underuse problem of space resources).

¹⁴⁷ R. Cargill Hall, *Comments on Salvage and Removal of Man-Made Objects from Outer Space*, 33 J. AIR L. & COM. 288, 290 (1967).

problematic.¹⁴⁸ Another approach would be to leave salvage to the determination of space-faring nations responsible and liable for their own debris. This too, however, presents a problem of incentivizing states to make salvage deals in the first-place due to the expense and risk.

To solve myriad of problems surrounding orbital salvage, it has been recommended that maritime salvage be adjusted in a way that better allows for application to orbit.¹⁴⁹ Specifically, the requirement of success and voluntariness must be loosened to limit the costs to salvors, thereby incentivizing participation.¹⁵⁰ This comment also posits that a dereliction amendment must be borrowed from existing maritime law and applied to orbital salvage in a way that halts ownership rights in orbital craft and debris after a fixed time. The loss of ownership would force states to either collect their debris or leave it free for claim by salvors.

A. *Direct Application of Maritime Salvage Law*

Applying existing maritime salvage law to orbit seems to make logical sense.¹⁵¹ Both outer space and the sea are vast areas, largely unexplored, and accessible to anyone with the appropriate equipment.¹⁵² Additionally, space and the sea have similar legal systems in which original owners maintain ownership and liability in sunken and non-operational debris.¹⁵³ The debris on the ocean floor and in orbit also share the distinction of representing the cultural heritage of their nation and of humanity.¹⁵⁴ For these reasons, application of maritime law would appear to make a good model for astrosalvage. However, while maritime law represents the closest parallel to the legal environment of outer space, there are differences between the two that make direct application impractical.¹⁵⁵

The salvage of orbital debris represents a much costlier and logistically more hazardous situation than salvage from the seabed. This distinction requires a change to the three salvage requirements to be applicable to space. Salvage requires that a vessel be in actual peril, that salvage be voluntary for both the owner and salvor, and that the salvage operation be at least partially successful for the salvor to collect any

¹⁴⁸ Fishman, *supra* note 9, at 985-86 (regarding the voluntariness and success requirements of maritime salvage law).

¹⁴⁹ *See id.*

¹⁵⁰ *Id.*

¹⁵¹ Jasentuliyana, *supra* note 10, at 9.

¹⁵² *See* Heim, *supra* note 126, at 821-22 (stating that the deep seabed, outer space, and Antarctica are considered the "common heritage of mankind").

¹⁵³ G.A. Res. 2222, *supra* note 8, at 14; *see also*, Kenneth E. Roberts, *Sinking, Salvage, and Abandonment*, 51 TUL. L. REV. 1196, 1197 (1976-1977).

¹⁵⁴ Eden Sarid, *International Underwater Cultural Heritage Governance: Past Doubts and Current Challenges*, 35 BERKLEY J. INT'L L. 219, 221 (2017); *see generally* Alice Gorman, *Saving space junk, our cultural heritage in orbit*, CONVERSATION (Apr. 2, 2012), <http://theconversation.com/saving-space-junk-our-cultural-heritage-in-orbit-6025>.

¹⁵⁵ Fishman, *supra* note 9, at 988.

reward.¹⁵⁶ The peril requirement is easily applied. Craft or debris must be in a situation that cannot be remedied without the intervention of the salvor.¹⁵⁷ Objects in orbit are, for the most part, stuck there until someone pulls them down, satisfying the low bar of actual peril.¹⁵⁸

Voluntariness and success, on the other hand, are difficult to apply in the same way they are applied to maritime salvage.¹⁵⁹ Voluntariness requires that the owner of the vessel consent to the salvage and that the salvor himself conduct the operation separate from any preexisting duty to the owner or the vessel.¹⁶⁰ Applied to astrosalvage, the voluntariness requirement presents two problems. First, the hazard presented by orbital debris presents a risk to the lives of any third party launching into outer space.¹⁶¹ At sea, wrecks and debris exist mostly on the ocean floor, allowing states and salvors the opportunity to negotiate rewards and plan salvage operations without risking the safety of other vessels.¹⁶² In space, however, each additional object in orbit makes subsequent launches more dangerous to complete.¹⁶³ Second, voluntariness is difficult to apply to astrosalvage because, while many objects are identifiable to their original owner through existing registries, many more objects are unidentifiable.¹⁶⁴ This prevents original owners from giving consent for objects to be collected.¹⁶⁵

The success requirement of maritime salvage also requires adjustment before it can be applied to astrosalvage.¹⁶⁶ At sea, the success requirement prevents the salvor from 'feigning at salvage' to collect rewards at minimal cost.¹⁶⁷ However, because of the high cost and potential hazards of getting into orbit to conduct salvage, the success requirement poses too high a bar.¹⁶⁸ Because of these inherent differences, direct

¹⁵⁶ Roberts, *supra* note 156, at 1197 ("In order to have a valid salvage claim, three elements are necessary: (1) Marine peril; (2) services voluntarily rendered, *i.e.*, not required as an existing duty or from a special contract; and (3) success, in whole or in part, or contribution to such success by the service rendered.") (first citing *The Sabine*, 101 U.S. 384 (1879); then citing MARTIN J. NORRIS, *THE LAW OF SALVAGE* 24 (1958)).

¹⁵⁷ Fishman, *supra* note 9, at 979.

¹⁵⁸ *See id.* at 985 (noting that the real peril requirement can be directly applied to orbital salvage law from maritime salvage law and that two other "traditional salvage requirements – voluntariness and success – are not suitable requirements for space salvage.").

¹⁵⁹ *Id.*

¹⁶⁰ *See id.* at 979-80.

¹⁶¹ *Id.* at 985.

¹⁶² Fishman, *supra* note 9, at 985.

¹⁶³ Salter, *supra* note 7, at 228 ("In this situation, the actions of each party are imposing costs on other parties, in the form of leaving orbit more crowded than it previously was, without the other parties' consent[.]")

¹⁶⁴ Jasentuliyana, *supra* note 10, at 11 ("[B]ecause of the untrackable and unidentifiable nature of most orbital debris, it is not known to whom all orbital debris belongs[.]")

¹⁶⁵ *Id.* at 13 (citing HOWARD A. BAKER, *SPACE DEBRIS: LEGAL AND POLICY IMPLICATIONS* 69-71 (1989)).

¹⁶⁶ Fishman, *supra* note 9, at 985.

¹⁶⁷ *See id.* at 980.

¹⁶⁸ *Id.* at 986.

application would be problematic without additional amendments and conditions aimed at minimizing risk and increasing opportunity for salvors.

B. *Good Faith Amendment to the Rescue Agreement*

Good faith simply means that parties who are conducting operations make a substantial investment and effort toward collecting orbital debris.¹⁶⁹ Because owners can track salvage operation remotely and because of the hazards of conducting salvage,¹⁷⁰ it has been recommended that a good faith salvage amendment be added to the Rescue Agreement to allow salvors the opportunity to conduct salvage with minimized risk.¹⁷¹ This good faith amendment would incentivize salvors to make good faith attempts because the amendment would remove the requirement of bringing back salvaged material to recoup operating costs.¹⁷² Additionally, the owners of debris would be free from worry that salvors are not undertaking proper efforts.¹⁷³

At sea, one of the only ways to demonstrate a proper effort at salvage is to bring home at least an identifiable portion of the craft or debris.¹⁷⁴ With this success requirement replaced with a good faith amendment, salvors could receive a percentage of their operating costs in the face of loss or mission failure. The nature of space and of earth's orbit is "inherently complex and uncertain," differing from the deep sea which has largely predictable conditions even without knowing the full topography of the seabed.¹⁷⁵ Because of this uncertainty, salvors will want a guarantee that they are going to receive some portion of payment once they have invested a determined amount of time and capital into an operation.¹⁷⁶ This amount could be set within the good faith amendment, "taking into consideration ... the expenses incurred by the [salvor], the value of the property salvaged, and the risk incurred by the [salvor] in conducting the operation,"¹⁷⁷ or by contract between the parties. Then, as in the Rescue and Liability Agreements, compensation claims could be made via diplomatic channels and conflicts would be decided by international courts.¹⁷⁸ The amendment would assume the ability of debris owners to track the progress of orbital operation and allow them to make determinations of good faith based on the investment and action taken by the salvor.

¹⁶⁹ *Id.* at 992.

¹⁷⁰ *See id.* at 991-92 ("A requirement of successful or even partially successful salvage under the inherently complex and uncertain conditions in space could create an undesirable disincentive to salvage.")

¹⁷¹ Fishman, *supra* note 9, at 988, 991-92.

¹⁷² *Id.* at 991-92.

¹⁷³ *Id.* at 992.

¹⁷⁴ *See* Roberts, *supra* note 156, at 1197.

¹⁷⁵ Fishman, *supra* note 9, at 992.

¹⁷⁶ *Id.* at 986.

¹⁷⁷ *Id.* at 989.

¹⁷⁸ *Id.* at 990, 988 (explaining that paragraph 6 of the proposed amendment incorporates by reference the dispute resolution procedures of the Convention on International Liability for Damage Caused by Space Objects).

This amendment would protect both salvors and the owners of debris. However, it only allows salvage of debris that is identifiable to the owner. Regarding the hundreds of thousands of pieces of debris that are unidentifiable or difficult to track,¹⁷⁹ exact agreements for salvage, even in good faith, would be virtually impossible.¹⁸⁰ Additionally, the good faith amendment, while protecting both salvors and owners and incentivizing salvors to enter the market, does not necessarily incentivize states to make salvage agreements in the first place. Without a threshold for dereliction, states will likely leave debris in orbit instead of collecting it.

C. *State Determination*

Another option is to allow states to determine and negotiate their own salvage agreements without the intervention of international law or any change to the current regime. Coastal states already have systems regarding the salvage and ownership of sunken objects.¹⁸¹ Salvors can simply contract with the government, setting the terms and payment for the collection of sunken or abandoned vessels. This works especially well for military or government vessels that the state wishes to keep from collection or identification for national security reasons.¹⁸² A similar system could be applied to space, in which launching states contract with salvors to collect only that orbital debris which belongs to the state. These contracts would clarify the terms of salvage and allow parties to negotiate for their own good faith compensation without adjusting or amending international law.

However, salvage determined purely by contracts between states and salvors fails to minimize or eliminate problems that exist within astrosalvage. First, without a substantial change to the law, there is nothing incentivizing state governments to engage in salvage any more than they already do.¹⁸³ Much of the existing debris would continue to orbit the earth because the cost to nations, even under contract, is too high to justify hiring a contractor.¹⁸⁴ Additionally, the state determination model would give an unfair bargaining advantage to states who are not being held to any standard of behavior.¹⁸⁵ This presents a disincentive to potential salvors because they are unable to dictate terms or costs to the extent they would need.¹⁸⁶

¹⁷⁹ Jasentuliyana, *supra* note 10, at 11 (“[B]ecause of the untrackable and unidentifiable nature of most orbital debris, it is not known to whom all orbital debris belongs.”)

¹⁸⁰ Fishman, *supra* note 9, at 992.

¹⁸¹ See generally Lipka, *supra* note 80, at 108-09.

¹⁸² See *id.* at 105-09.

¹⁸³ Salter, *supra* note 7, at 228.

¹⁸⁴ See *id.* at 233, 236.

¹⁸⁵ See *id.* at 233-34.

¹⁸⁶ *Id.* at 230 (“A clearly announced legal rule placing the financial burden (of coping with spacecraft destroyed by debris) on private actors would incentivize investment in technologies that would help cope with existing debris.”)

D. *The Good Faith and Dereliction Amendment*

The introduction of the above good faith amendment is the strongest recommendation mentioned and would be the most effective way to protect owners and salvors while encouraging active market participation. It does not, however, go far enough to encourage states to mitigate orbital debris and engage in salvage operations with private entities. The introduction of an additional dereliction amendment, in which owners of orbital debris lose their claim after a certain number of years, would put pressure on states to internalize the costs of their debris and place power in the hands of salvors to negotiate terms. This would go a long way towards eliminating the environmental and safety hazard presented by orbital debris and create a market for salvage that would benefit the global market.

Dereliction, or abandonment, occurs when the original owner of a craft or debris deliberately abandons it without hope of recovery and without intention of recovering it.¹⁸⁷ Dereliction is evidenced by an express waiver of ownership rights, non-use of the object, or a lapse of time demonstrating *sine animo revertendi*.¹⁸⁸ In applying dereliction, the law of finds would supplant the law of salvage, granting the finder rights superior to everyone but the original owner (if the owner has expressed an interest in collecting on the property).¹⁸⁹ Conflicts over dereliction are decided by the courts of the state in which the owner is a citizen.¹⁹⁰ To overcome dereliction, it must be shown that the object can be identified to the original owner who is asserting claim and that the owner did not deliberately abandon the object.¹⁹¹

Dereliction would be simple to apply to the salvage of orbital debris. Over time, many pieces of orbital debris have been created, ranging in size from the size of a grain of rice to the size of spacecraft.¹⁹² Some objects, such as satellites, simply stop working and are left non-operational in orbit indefinitely.¹⁹³ This article recommends that the perpetual ownership in these objects, established by the Outer Space Treaty and maintained by the Registration and Liability agreements, be amended in cases where debris has been left unrepaired or unmaintained for twenty years or more. This amendment would not be applied retroactively, and would apply the statutory period to all non-operational debris from the

¹⁸⁷ Nafziger, *supra* note 115, at 343.

¹⁸⁸ *Id.*

¹⁸⁹ *Id.* at 343-44 (quoting *Cobb Coin Co., Inc. v. Unidentified, Wrecked and Abandoned Sailing Vessel*, 525 F.Supp. 186, 195 n.3 (S.D. Fla. 1981)).

¹⁹⁰ This implies that the object is not found in international waters. *See generally* G.A. Res. 2345, *supra* note 14; G.A. Res. 2777, *supra* note 15; G.A. Res. 3235, *supra* note 16.

¹⁹¹ *See* Jasentuliyana, *supra* note 10, at 11.

¹⁹² Garcia, *supra* note 3.

¹⁹³ Sandra May, *What is Orbital Debris?*, NASA, <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-orbital-debris-k4.html> (last updated Aug. 7, 2017).

moment of ratification. After that period, objects will become derelict, the property of no one, and open for collection by interested parties.

Assuming acceptance of the amendment, this would incentivize states and private actors to go into orbit to collect debris before the statute of limitations expires to prevent rival nations or firms the opportunity to profit from their investment. For launching states, this would mean that they are given ample opportunity to either collect or repair debris or risk losing their investment. The amendment would also encourage states to minimize future debris that could be collected and used by other state or private actors.¹⁹⁴ This minimization of debris would address the environmental and safety concerns associated with orbital debris, making future launches safer.¹⁹⁵ For salvors, this would create an opportunity to collect, repurpose, and sell orbital debris for scientific and commercial purposes and create a market for collectors to obtain objects that have floated in Earth's orbit.¹⁹⁶ Additionally, the amendment would allow salvors to collect the smaller and unidentifiable pieces of debris without the permission of launching states, thereby continuing to diminish the cloud of debris endangering orbital missions.¹⁹⁷ Finally, this new market would spur innovation as potential salvors race to collect objects in space.¹⁹⁸ Ownership of these objects could even be reserved on a temporary basis in conjunction with the good faith amendment to allow a statutory period of collection that begins when a salvor announces an intention to collect an object. Conflicts over these claims could be decided by courts within the nation of either party.

Albeit, approval of such an amendment is based on a large assumption. For the same reasons that states don't clean up their current debris, states are unlikely to willingly give up their property rights without proper motivation. Aside from economic concerns, there are national security concerns that are sure to keep some nations from agreeing to a dereliction amendment. History has demonstrated that states will only act if the liability risk of debris becomes too high or if enough development has occurred in salvage markets domestically to bring the value of salvage back

¹⁹⁴ See Jasentuliyana, *supra* note 10, at 18-19.

¹⁹⁵ Salter, *supra* note 7, at 235 (“[I]f five sufficiently large pieces of debris are removed per year over the next 100 years, orbital access and LEO can be stabilized. 57 However, stabilization is conditional on (a) all future launches, including non-US launches, complying with NASA guidelines concerning deorbiting and (b) no new major collisions creating new debris in the interim.”) (citing Liou, *supra* note 142, at 648).

¹⁹⁶ See *id.* at 234-35.

¹⁹⁷ Jasentuliyana, *supra* note 10, at 7 (“It is estimated that for every trackable object, 20 untrackable 1 centimeter objects and 10,000 untrackable 1 millimeter objects are created. Because only objects of a certain size can be catalogued, only estimates can be made on the actual number of objects that exist in orbit.”) (citing DAVID S. F. PORTREE, ET AL., *ORBITAL DEBRIS AND NEAR-EARTH ENVIRONMENTAL MANAGEMENT: A CHRONOLOGY 1* (Lyndon B. Johnson Space Center, 1993)).

¹⁹⁸ See Michael Cooney, *Lost in space: The space junk conundrum*, HEWLETT PACKARD ENTERPRISE (Apr. 4, 2018), <https://www.hpe.com/us/en/insights/articles/lost-in-space-the-space-junk-conundrum-1804.html>.

to their home states.¹⁹⁹ In the meantime, potential concerns could be addressed by other requirements on salvors, such as volume caps, which prevent states from completely abandoning their ownership. Such caps are not within the scope of this comment, but are certainly worth discussing.

Obstacles to the identification and collection of debris, and in the ratification of the proposed amendment, do not diminish its necessity. The collection and sale of orbital debris would reap value from objects that are not being used and providing no benefit.²⁰⁰ A good faith and dereliction amendment would incentivize states and private actors to collect all orbital debris, not just that which is identifiable to its launching states. In this way, orbital debris can benefit all of mankind by encouraging launching states to mitigate their debris and allowing salvors to collect abandoned objects for personal and industry gain.

VI. CONCLUSION

The current space law regime is not designed effectively to diminish orbital debris or managing salvage operations. In the meantime, objects are being launched into space, each creating more of a hazard to the environment and to the safety of future missions.²⁰¹ This problem is then aggravated by states' perpetual ownership in orbital debris,²⁰² which puts no pressure on states to mitigate their debris.²⁰³ Even if maritime salvage law were to be applied, the requirement of success and voluntariness would stop salvors from engaging in salvage because the risk is too high for the rewards that are proposed.

Instead, the international community must amend the Rescue and Liability Agreements to include good faith and dereliction clauses that, respectively, partially reimburse salvors for their investment and allow for the ownership of abandoned and non-operational spacecraft and debris after a statutory period.

It is worth mentioning that such amendments would not likely be passed or ratified by the global community, especially by more developed nations who do not wish to jeopardize their orbital property rights. This reflects two motivations on the part of the signatory states. First, states are unlikely to sign amendments in which they lose their investment to unknown parties. Second, the risk of liability may simply not be high enough, currently, to incentivize states to bind themselves to dereliction. This reluctance to change is motivated by the same impulses that stop nations from cleaning up orbital debris in the first place. However, a lack of willingness to adopt the amendments does not change their level of

¹⁹⁹ See *supra* Part III.

²⁰⁰ Salter, *supra* note 7, at 233.

²⁰¹ *Id.* at 226.

²⁰² G.A. Res. 2222, *supra* note 8, at 14.

²⁰³ Salter, *supra* note 7, at 228.

necessity. With the addition of these amendments to the Rescue and Liability agreements, the hazard of orbital debris will decrease while at the same time bringing value to objects that currently benefit nobody.

Finally, the proposed good faith and dereliction amendment is not meant to be a cure-all. Mankind's interaction with space is only going to increase, and more launches will naturally result in more debris. There are also sure to be additional challenges and conditions that are currently unforeseeable, both in orbit and internationally, that could affect orbital salvage and space exploration in general. Despite this, foundational salvage amendments need to be put in place, addressing issues proactively before the orbital debris problem becomes untenable.