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Note, When Wishing on a Star Just Won't Do: The Legal Basis for International Cooperation in the Mitigation of Asteroid Impacts and Similar Transboundary Disasters

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When Wishing on a Star Just Won't Do: The Legal Basis for International Cooperation in the Mitigation of Asteroid Impacts and Similar Transboundary Disasters

*Evan R. Seamone**

I.	INTRODUCTION	1093
II.	THE SERIOUS THREAT OF EARTH COLLISIONS WITH SPACE BODIES	1101
	A. REASONS FOR CONCERN OVER THE DANGERS POSED BY EARTH IMPACTS.....	1101
	B. FAILURES IN THE DEVELOPMENT OF EARTH IMPACT MITIGATION PROTOCOLS	1105
III.	OVERCOMING BARRIERS TO MITIGATION EFFORTS.....	1108
	A. ABANDONING PUBLIC INDIFFERENCE TOWARDS OUTER SPACE RISKS ..	1108
	B. RELYING ON ORGANIZATIONAL COORDINATION BEYOND THE SCOPE OF CURRENT DISASTER RESPONSE EFFORTS.....	1111
	C. REJECTING BLAME ALLOCATION AS THE MEANS TO ESTABLISH INTERNATIONAL DUTIES	1114
IV.	LEGAL FRAMEWORK	1117
V.	THE HISTORICALLY ENTRENCHED RIGHT TO GLOBAL SURVIVAL.....	1119

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A.	<i>THE DUTY OF SELF-PRESERVATION</i>	1119
B.	<i>SELF-PRESERVATION AS DISTINCT FROM NEWER AND MORE ABSTRACT RIGHTS TO THE ENVIRONMENT</i>	1121
C.	<i>NATIONS' DUTIES TO COOPERATE IN PRESERVING THEIR SUBJECTS' SURVIVAL</i>	1125
VI.	MODERN MANIFESTATIONS OF THE GLOBAL DUTY TO COOPERATE IN SELF-PRESERVATION EFFORTS	1130
A.	<i>DUTIES TO WARN OF IMPENDING DANGER</i>	1131
B.	<i>DUTIES TO ACT BEYOND WARNING</i>	1133
VII.	RECOMMENDATION AND CONCLUSION.....	1135

I. INTRODUCTION

You would feel as though you were in an oven turned on to broil. An enormous hole has been gouged in the Earth. Then, finally, the sky would turn black, absolutely, completely black—everywhere all over the world.¹

At first glance, with the horrors of the recent World Trade Center attacks fresh in their memory, readers might interpret this apocalyptic prediction as an attempt by the media to raise consciousness about the possibility of a nuclear bombing by terrorists.² Based on the public's rush to purchase survival equipment in response to the media's coverage of the events following September 11, 2001, Americans would probably treat the prediction quite seriously.³ In reality, however, the prediction addresses asteroid or comet collisions with the Earth.

Because bombardments of the Earth by objects from space are potentially as unpredictable and dangerous as terrorist attacks, a key concern is whether public reactions to the prediction above would be similar.⁴ In this instance, simply substituting a different type of disaster would probably result in an entirely different response.⁵ Denial and

1. ASTEROIDS: DEADLY IMPACT (National Geographic Television, Inc. 1997) [hereinafter VIDEO] (comments of Dr. Eugene Shoemaker).

2. The public's increased dependence on the media to inform it of potential threats stemming from the attacks on America may have arisen from generally "responsible" and "controlled" coverage, which has prompted some networks to recognize a new obligation to the public. Jason McFarley, *New York Times Reporter Critiques Terrorist Coverage in Notre Dame Speech*, UNIVERSITY WIRE, Oct. 8, 2001, available at LEXIS, Nexis Library, News Group File. For example, in the advent of terrorism, Pat Mitchell, President and CEO of the Public Broadcasting System (PBS), recognized the "unique position" of reporters to "shape a new balance between freedom and security, [and] between knowledge and response." Pat Mitchell, *Real World or "Reality" Shows?*, WASH. POST, Oct. 16, 2001, at A23, available at LEXIS, Nexis Library, News Group File. Recognizing the increased presence of the media in citizens' lives, not to mention the media's role in providing useful information to the public, eye-catching reminders of potential threats similar to the quote above are practically obligatory.

3. See Kim Peterson, *Some Folks Go on Shopping Spree for Survival, Military Equipment*, COPLEY NEWS SERVICE, Oct. 13, 2001, at 1-2, available at LEXIS, Nexis Library, News Group File (explaining how military surplus stores have been selling out of various survival gear, even though some merchants have raised prices as much as sixfold as compared to times predating September 11, 2001).

4. See *infra* Part II.A (exploring the dangers posed by asteroid or comet collisions with Earth).

5. See *infra* notes 84-87 and accompanying text (addressing public reactions to predictions of harm relating to space bodies).

avoidance would be the most likely outcomes.⁶ Inevitably, some people would scoff at the notion, just as they did when astronomers predicted the likelihood of similar Earth collisions in 1998 and in 2000.⁷ On both occasions, notwithstanding the supposed certainty of the estimates, dust from unsold survival gear drifted across the empty aisles of military surplus stores like tumbleweeds through the streets of a ghost town.⁸

Should policymakers and emergency preparedness personnel be concerned that members of the public discriminate in their reactions to different types of disaster? This Note explains why the international public, and more precisely lawmakers, must treat infrequent, but extremely dangerous, natural disasters more seriously. It argues that nations are violating international law when they neglect the mitigation of exotic transboundary crises. It highlights how the repercussions from such harmful events cannot be as easily addressed by routine procedures that nations typically employ when responding to more commonplace disasters.⁹ Ultimately, these generic measures have created a false sense of security.¹⁰

Certain characteristics make some natural disasters more serious than others. After all, sudden onset crises like tsunamis are more threatening than dangers posed by gradually rising water levels created by global warming.¹¹ These differences prompt emergency response planners to factor the public's level of disaster preparation into their rankings of threat magnitude.¹² Consequently, those threats to which nations regularly respond are potentially less dangerous than the ones that rarely, if ever, occur. The more common natural disasters include: thunderstorms,¹³ typhoons,¹⁴ tornadoes,¹⁵ and earthquakes.¹⁶

6. See *infra* notes 84-87 (exploring a general sense of apathy and disinterest among members of the public and the mass media and sensationalism in the entertainment industry).

7. See *infra* note 87 (addressing the public's reactions to scientists' recent Earth impact predictions).

8. See David Kaplan, *Col. Bubbie's Owner Benefits from Surplus of Humor, War Supplies*, HOUSTON CHRON., Oct. 21, 2001, at 1, available at LEXIS, Nexis Library, News Group File (noting the reasons why "the number of Army-Navy surplus stores in America has dwindled in recent decades," and that many are surviving mainly as a result of consumers' responses to the attacks on America and the previous Y2K predictions).

9. See *infra* notes 97-99 and accompanying text (addressing the organizational difficulties that impede attainment of the objectives of international disaster response coalitions).

10. See *infra* notes 97-99 (observing obstacles that limit the capabilities of multinational hazard mitigation efforts).

11. See J.M. ALBALA-BERTRAND, POLITICAL ECONOMY OF LARGE NATURAL DISASTERS: WITH SPECIAL REFERENCE TO DEVELOPING COUNTRIES 9 (1993) (discussing the sudden onset category of natural disasters and distinguishing it from variations of gradual onset disaster, for which most nations have advance notice).

12. See WORLD HEALTH ORG., COMMUNITY EMERGENCY PREPAREDNESS: A MANUAL FOR MANAGERS AND POLICY-MAKERS 5 (1999) ("Vulnerability to emergencies and disasters is a function of the degree of exposure to hazards and of people's capacity to cope with hazards and their consequences.").

13. KENDRICK FRAZIER, THE VIOLENT FACE OF NATURE: SEVERE PHENOMENA AND NATURAL

Disaster planners sometimes cram the more infrequent threats into the overarching category of “low probability, high consequence” events.¹⁷ Normally, policymakers must devote extra effort in preparing for such occurrences because of the unknown risks involved.¹⁸ For example, even when the chances are minimal that a public area is polluted by carcinogens, the Comprehensive Environmental Response, Compensation and Liability

DISASTERS 13 (1979) (“At any given moment, 1,800 thunderstorms are in progress over the earth’s surface.”).

14. *Id.* (“If the season is late summer, one or more of . . . 50 hurricanes or typhoons is . . . moving toward a populated coastline.”).

15. *Id.* (explaining that “600 to 1,000 [tornadoes] a year [occur]”).

16. *Id.* (observing how “15 to 20 times a year a quake strikes with enough energy to cause widespread death and destruction”).

17. Similar to massive biochemical contamination, for example, Earth impacts with space bodies occupy this classification. Compare *The Environmental Implications of Genetic Engineering, Before the Subcomm. on Investigations and Oversight and the Comm. on Sci. and Tech. of the House Comm. on Sci. and Tech.*, 98th Cong. 2d Sess. V, at 9 (Feb. 1984) (Staff Report):

[P]otential environmental risks associated with the deliberate release of genetically engineered organisms or the translocation of any new organism into an ecosystem are best described as ‘low probability, high consequence risk’; that is, while there is only a small possibility that damage could occur, the damage that could occur is great.

with Michael B. Gerrard & Anna W. Barber, *Asteroids and Comets: U.S. and International Law and the Lowest-Probability, Highest Consequence Risk*, 6 N.Y.U. ENVTL. L.J. 4, 4 (1997):

Asteroids and comets pose unique policy problems. They are the ultimate example of a low probability, high consequence event: no one in recorded human history is confirmed to have ever died from an asteroid or a comet, but the odds are that at some time in the next several centuries (and conceivably next year) an asteroid or comet will cause mass localized destruction and that at some time in the coming half million years (and conceivably next year), an asteroid or comet will kill several billion people.

Despite their low probability, historians have attributed several deaths to space bodies. See *infra* notes 53 and 56 and accompanying text (describing deaths reported during China’s Former Han Dynasty and in more recent times).

18. See Colin S. Diver, *Policymaking Paradigms in Administrative Law*, 95 HARV. L. REV. 393, 431-32 (1981) (noting that policymakers should institute “comprehensive” programs to reduce risks in “unstable environments” whenever “small errors in policy can cause irreversible or even catastrophic harm,” and citing the regulation of nuclear power plants, carcinogenic substances in food, consumer products, and endangered species as examples of such instances); Thomas O. McGarity & Karl O. Bayer, *Federal Regulation of Emerging Genetic Technologies*, 36 VAND. L. REV. 461, 486 (1983) (“When conduct entails a very small probability of a very high consequence accident, the regulatory entity must ensure that the accident never happens.”). Preplanning effectively, even without verifiable data, seems the ideal institutional response. The Rio Earth Summit, for example, stressed the importance of preventive measures to deal with environmental crises: “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” UNITED NATIONS CONFERENCE ON THE ENVIRONMENT AND DEVELOPMENT: RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT, U.N. Doc A/CONF. 151/5/Rev. 1, reprinted in 31 I.L.M. 874, at prin. 15 (1992) [hereinafter RIO DECLARATION].

Act (CERCLA)¹⁹ requires a site to be decontaminated if tests indicate that one person in one million will contract cancer.²⁰ However, even in cases where some unknown threats pose potentially greater harm than others, planners allocate more resources to those threats that seem less far-fetched.²¹

Owing to political lobbying and cost benefit analyses in democratic societies, public planners will prioritize their responses to threats based on their familiarity with the risks posed.²² With a prompt and substantial allocation of resources, planners can theoretically measure the effectiveness of these commitments and increase the benefit society derives from the improvements they implement.²³ Unfortunately, this reasoning ignores the fact that megadisasters can, and do, occur.²⁴ Examples of these rare but possible devastating crises include the Black Death of the Middle Ages,²⁵ the Mount Vesuvius eruption in Italy in Roman Times,²⁶ the New Madrid earthquake that "ripped the Mississippi Valley apart" in the early nineteenth century,²⁷ the potential collapse of the Cumbre Vieja volcano in the Canary

19. 42 U.S.C. §§ 9601-9675 (1994 & Supp. V. 1999).

20. 40 C.F.R. § 300.430(e)(2)(i)(A)(2) (1996). Cf. Wendy E. Wagner, *Choosing Ignorance in the Manufacture of Toxic Products*, 82 CORNELL L. REV. 773, 838 n.241 (1997) ("Common-law courts could consider regulatory standards for determining when a risk becomes significant. Typically, Congress and regulatory agencies consider risks greater than one in one million to be publicly unacceptable . . .").

21. As Professors Gerrard and Barber observe, Congress treats less severe threats than asteroid impact with greater priority, in stark contrast to the rule favoring prevention of more serious risks. See Gerrard & Barber, *supra* note 17, at 13 (assuming a one in 4000 chance of asteroid fatality versus a one in one million chance of cancer acquisition).

22. For example, see Colin F. Camerer & Howard Kunreuther, *Decision Processes for Low Probability Events: Policy Implications*, 8 J. POL'Y ANALYSIS & MGMT. 565, 570 (1987), for a description of how people make such determinations with measurable bias.

23. In the United States, crucial aspects of the government's efforts to coordinate disaster response at the federal level are continuing policy assessments of program effectiveness and the legal responses resulting therefrom. See Rutherford H. Platt & Claire B. Rubin, *Stemming the Losses: The Quest for Hazard Mitigation*, in *DISASTERS AND DEMOCRACY: THE POLITICS OF EXTREME NATURAL EVENTS* 69, 72-74 & fig.3-2 (Rutherford H. Platt ed., 1999) (describing the "interconnection of natural hazards, the built environment, and the legal/political system").

24. Transboundary megadisasters are the types of international crises that condition the success of disaster response on the existence of shared duties and obligations. Some characterize the issue as one of environmental security or "threats to national well-being or the common interests of the international community associated with environmental damage." JONATHAN I. CHARNEY, *THE OCEANS AND ENVIRONMENTAL SECURITY: SHARED U.S. AND RUSSIAN PERSPECTIVES* 6 (James M. Broadus & Raphael V. Vartanov eds., 1994) [hereinafter *OCEANS*].

25. See generally FRANCIS AIDAN GASQUET, *THE BLACK DEATH OF 1348 AND 1349* (1908) (exploring the disease's impact).

26. Alexandre Dumas, the historian responsible for excavations of Pompeii and Herculaneum in 1860, noted: "It must be admitted that Vesuvius revealed itself to the world by a master stroke. To cover land and sea with a black cloud; to send its ashes as far afield as Africa, Syria, and Egypt, to bury two cities . . . is not bad at all for a volcano that is only just setting out on its career." WILLIAM HOFFER, *VOLCANO: THE SEARCH FOR VESUVIUS* 13 (1982).

27. WILLIAM ATKINSON, *THE NEXT NEW MADRID EARTHQUAKE: A SURVIVAL GUIDE FOR THE*

Islands that could trigger 150-foot tsunami waves reaching the U.S. East Coast, Brazil, and portions of England,²⁸ or the potential mutation of the Auto Immune Deficiency Syndrome (AIDS) into an airborne virus.²⁹ In the aftermath of these possible but unpredictable crises, the international community would have to mitigate harm in entirely new ways. The question becomes one of whether planners are responding effectively to the potential repercussions of a crisis when they cast doubt on the likelihood of the occurrence and such doubt results in a limited allocation of resources.³⁰ With defeatist logic prevailing in legislative and organizational circles, it is wrong to suggest that planners are effectively working to “mitigate” the threats of nontraditional megadisasters.

Disaster mitigation involves a number of combined measures to respond to threats, including efforts to anticipate damage before it occurs and develop solutions for varying levels of devastation.³¹ Because

MIDWEST 1 (1989). Professor Atkinson explains that, similar to a catastrophic asteroid impact, another New Madrid will “definitely occur *sometime*,” although that time remains unknown. *Id.* (emphasis in original).

28. See *Tsunami from Volcano Could Destroy E. Coast*, ARIZ. REPUBLIC, Aug. 30, 2001, at B10 (predicting damage). For similar predictions related to California’s separation from North America, see PETER BRIGGS, *WILL CALIFORNIA FALL INTO THE SEA?* vii (1972), discussing the loosely fitted oceanic plates that, one day, could disjoint violently from quakes occurring along the San Andreas Fault.

29. See Dawn Brazell, *Exotic Strains Not the Only Ones to Worry About*, POST & COURIER (Charleston, SC), Mar. 23, 1995, at B1, available at LEXIS, Nexis Library, News Group File (describing “rag[ing]” debates “in the scientific world” about this possibility); cf. RICHARD PRESTON, *THE HOT ZONE 408* (Anchor Books 1995) (1994) (noting the following: “The AIDS virus is a fast mutator; it changes constantly. It is a hypermutant, a shape shifter, spontaneously altering its character as it moves through populations and through individuals. It mutates even in the course of one infection . . .”).

30. See *infra* notes 101-02 and accompanying text (discussing failures in the emergency planning processes attributable to government agencies’ overreliance on untested and often unverifiable contingencies).

31. Disaster response personnel define mitigation as “steps taken to eliminate or reduce the probability of disaster [including] stricter building codes, land-use regulation, [and] relocations.” Beverly A. Cigler, *Emergency Management and Public Administration*, in *CRISIS MANAGEMENT: A CASEBOOK* 5, 7 (Michael T. Charles & John Choon K. Kim eds., 1988) [hereinafter *CRISIS MANAGEMENT*]; see also Samuel Speck, *Overview of Post Disaster Mitigation Issues and Opportunities: The U.S. Experience*, in *SYMPOSIUM, HOUSING AND URBAN DEVELOPMENT AFTER NATURAL DISASTERS: POST DISASTER RESPONSE AND MITIGATION OF FUTURE LOSSES* 9, 9 (1985) [hereinafter *ABA DISASTER SYMPOSIUM*] (“Hazard mitigation is the conscious evaluation of the impact of a hazard and the implementation of measures which eliminate or reduce our vulnerability to its effects.”). Furthermore, “[t]hree opportunities may arise to intervene in the course of a hazard: (1) before the hazardous condition occurs or is created; (2) before the effects of the hazard become significant; or (3) after the serious effects of the hazard have been experienced.” *Id.* For example, when mitigating volcano eruptions, crisis response personnel do not merely measure the temperature of the lava or the intensity of its buildup. “Mitigation measures taken prior to volcanic eruptions included partial evacuation of hazardous areas and increased readiness levels.” Janet K. Bradford et al., *The Eruption of Mount St. Helens*, in *CRISIS MANAGEMENT, supra*, at 151, 152.

transboundary disasters touch the farthest reaches of the globe and threaten the stability of the international system of governance, appropriate responses must necessarily be international in scope.³² The spreading of losses and the conservation of resources would likewise favor the notion that nations should work together in mitigating such natural disasters.³³ From these simple assumptions, the emergence of some sort of international committee on transboundary disaster response should follow. Yet, the effectiveness of organizations like the United Nations in addressing even the more common variations of natural disaster is open to question.³⁴

This limited response to international crises may stem from two criticisms of international law. To a large extent, ineffectiveness results from the fact that the principles underlying international cooperation are steeped in moral obligations, which often are in conflict with the sovereign rights of nations.³⁵ In short, considerations of goodwill and cultural exchange fail to

32. See COMM. ON THE ENV'T & NATURAL RES. SUBCOMM. ON NATURAL DISASTER REDUCTION, NAT'L SCI. & TECH. COUNCIL, NATURAL DISASTER REDUCTION: A PLAN FOR THE NATION 24 (1996) [hereinafter PLAN FOR THE NATION] ("The resulting unrest [from natural disasters] contributes significantly to global geopolitical instability."). As Congress recognized in the Federal Emergency Management Agency's enabling legislation, "disasters often disrupt the normal functioning of governments and communities." 42 U.S.C. § 5121(a)(2) (1994).

33. See GUIDO CALEBRESI, THE COST OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS 39 (1970) (reviewing the economic advantages of interpersonal loss spreading).

34. See Zama Coursen-Neff, *Preventive Measures Pertaining to Unconventional Threats to the Peace Such as Natural and Humanitarian Disasters*, 30 N.Y.U. J. INT'L L. & POL. 645, 647-48 (1998) (explaining inadequacies in disaster response coordination and planning among United Nations affiliates).

35. Take, for example, more developed nations' treatment of the Global Commons, which include the weather, the high seas beyond a country's accepted boundary, Outer Space, and Antarctica. See generally Harlan Cleveland, *Introducing the Global Commons*, NAT'L FORUM, Jan. 1990, at 4 (defining the term and describing how States have recognized these resources internationally in legal instruments). While almost all countries have generally addressed obligations to provide free access to the Commons, these moral considerations fall short of any sort of duty to assist those countries with fewer resources. See V.S. Mani, *The Common Heritage of Mankind: Implications for the Legal Status of Property Rights on the Moon and Celestial Bodies*, in PROCEEDINGS OF THE THIRTY-NINTH COLLOQUIUM ON THE LAW OF OUTER SPACE 31, 31-37 (1996) [hereinafter PROCEEDINGS] (discussing the conflicting ideals of developed and developing nations). Here, as in many cases, nations refuse to commit resources even though they have subscribed to overarching principles that would morally bind them to action. See Henri A. Wassenbergh, *The International Regulation of an Equitable Utilization of Natural Outer Space Resources*, in PROCEEDINGS, *supra*, at 138, 139 ("Principles [governing the Global Commons] are formulated in such a way that they remain completely non-committal, open-ended and merely reflecting the good intentions of the States."). The difficulty of allocating resources in the deep seabed is the most telling sign that developed countries are not interested in collaborative efforts. See Louis de La Fayette, *Common Heritage or Burden? The United States Position on the Development of a Regime for Deep Sea-Bed Mining in the Law of The Sea Convention*, 86 AM. J. INT'L L. 212, 214 (1992) (reviewing MARKUS G. SCHMIDT, COMMON HERITAGE OR COMMON BURDEN? THE UNITED STATES POSITION ON THE DEVELOPMENT OF A REGIME FOR DEEP SEA-BED MINING IN THE LAW OF THE SEA CONVENTION (1989)) (noting that the United States repeatedly cited economic and "national security" concerns as the reasons for refusing to adopt a jointly managed sea-bed mining regime).

outweigh the concerns of individual States about their own narrow interests.³⁶ Yet another reason explains why international lawmaking entities have largely ignored delineating responsibility for serious transboundary disasters.³⁷ Simply put, nations have doubted the legitimacy of international law.³⁸ In either instance, irresponsiveness to the question of international natural disaster mitigation arises because nations do not recognize their legal obligations.³⁹ Further development of the legal principles underlying

36. In the face of disaster, absent a treaty or recognized legal obligation, nations that are naturally concerned with their own survivability may decline to participate in collaborative efforts on the familiar grounds that "a state is not subject to any external authority unless it has voluntarily consented to such authority." Louis Henkin, *International Law: Politics, Values and Functions*, 216 RECUEIL DES COURS 27 (1989); see also S.S. Lotus Case (Fr. v. Turk.), 1927 P.C.I.J. (ser. A.) No. 10 (Sept. 7), at 18 ("The rules of law binding upon States therefore emanate from their own free will . . . Restrictions upon the independence of States cannot therefore be presumed.").

37. As it now stands, with regard to Earth impacts, nations have no definitive guidance regarding the following crucial inquiries:

Shall States enter into new or more organized arrangements for asteroid detection? . . . Shall States and the international community enter into preliminary discussions as to asteroid detection? . . . How shall the matter of dissemination of information of detection of activities and dissemination of particulars of an asteroid impact be accomplished? . . . How shall decision making as to asteroid deflection be made? Who will take action and under what conditions and safeguards?

Eugene Brooks, *Dangers From Asteroids and Comets: Relevance of International Law and Space Treaties*, in PROCEEDINGS OF THE FORTIETH COLLOQUIUM ON THE LAW OF OUTER SPACE 234, 248 (1997) [hereinafter FORTIETH COLLOQUIUM]; see also Clark R. Chapman et al., *The Comet/Asteroid Impact Hazard: A Systems Approach* 10-11 (Feb. 24, 2001) (unpublished whitepaper, on file with the Southwest Research Institute Office of Space Studies), available at <http://www.boulder.swri.edu/clark/neowp.html> (identifying several similar unresolved "Social/Political/Economic/Technological Issues").

38. Commentators have often doubted the reach of international law. See Geoffrey Palmer, *New Ways to Make International Environmental Law*, 86 AM. J. INT'L L. 259, 259 (1992) (explaining how international lawmaking is "slow, cumbersome, expensive, uncoordinated and uncertain"); Geoffrey R. Watson, *The Death of Treaty*, 55 OHIO ST. L.J. 781, 782 (1994) (observing the view that "international law is not 'law' at all because it cannot be readily enforced"). For example, from 1946 to 1984, the United States recognized the compulsory jurisdiction of the International Court of Justice (ICJ). However, when the ICJ permitted Nicaragua to sue America for conducting paramilitary operations within its borders, see generally *Case Concerning Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.)*, 1984 I.C.J. 392 (Nov. 26), the Department of State withdrew its earlier recognition of the Court's jurisdiction, see *U.S. Terminates Acceptance of ICJ Compulsory Jurisdiction*, 1986 DEP'T ST. BULL., Jan. 1986, at 67, reprinted in 24 I.L.M. 1743, 1744-45 (1985), and defied the terms of the ICJ's holding, which found America liable for monetary damages. See BARRY E. CARTER & PHILLIP R. TRIMBLE, *INTERNATIONAL LAW* 331-32 (3d ed. 1999) (discussing the U.S. government's reaction to the ICJ's judgment).

39. That scholars are unclear regarding why nations comply with legal obligations, see Robert O. Keohane, *International Relations and International Law: Two Optics*, 38 HARV. INT'L. L.J. 487, 491 (1997) ("We do not yet have a well-specified or empirically tested instrumentalist theory of compliance with international commitments."), does not obscure the fact that such duties have measurable weight. See ABRAM CHAYES & ANTONIA HANDLER CHAYES, *THE NEW*

the necessity of State action in the realm of international disaster relief will be necessary to counteract these negative forces.

This Note uses the threat of collisions of large space bodies with the Earth as a vehicle to investigate the legal duties of nations to participate in collective efforts at megadisaster mitigation. Asteroids and comets are space bodies while meteors occupy a less-threatening category.⁴⁰ Although they differ in chemical composition and in visibility to the naked eye, large space bodies can endanger multiple nations simultaneously.⁴¹ Space bodies are ideal topics of investigation because the magnitude of the threats they pose is inestimable.⁴² Legal obligations to mitigate Earth impacts apply equally well to other infrequent threats that are currently of the lowest priority among disaster response personnel.⁴³

This Note adopts a five-part analytical approach in investigating the legal obligations to mitigate Earth impacts. Part II explores the reality of the threats posed by space bodies. Part III investigates obstacles that have limited the ability of nations to mitigate such threats. Part IV identifies the sources of law underlying international legal obligations to act and prevent or minimize such harm. Parts V and VI review numerous practices adopted by

SOVEREIGNTY: COMPLIANCE WITH INTERNATIONAL REGULATORY AGREEMENTS 3-9 (1995) (explaining reasons why “foreign policy practitioners operate on the assumption of a general propensity of states to comply with international obligations”).

40. Comets, asteroids, and meteorites are all different entities. Both comets and asteroids are large, while meteorites are most often small fragments of asteroids that reach the surface of the Earth and pose no serious international threat. See *What is the Difference Between Comets, Asteroids, and Meteors?*, at <http://image.gsfc.nasa.gov/poetry/ask/a10590.html>:

Comets are balls of ice about 1-100 kilometers across, mixed in with pebbles and rocky material like a ‘dirty snowball’. Asteroids are large 100-meter to 500-kilometer rocky bodies that mostly are found in the asteroid belt between Mars and Jupiter. Meteorites are small pieces of rock or ice from asteroids or comets that intersect the Earth and enter its atmosphere to produce meteors or ‘shooting stars’.

See also E-mail from Clark R. Chapman, Southwest Research Institute, to Evan R. Seamone, (Dec. 23, 2001) (on file with author) (explaining that “the low end of the size range [of comets and asteroids] is a bit fuzzy but roughly 10 meters—some might say 1 meter, other may say tens of meters” and that the small size of meteorites is incomparable to comets or asteroids).

41. See *supra* text accompanying note 1, *infra* notes 44, 47-49, and 64 and accompanying text (describing predicted damage from space bodies that is both significant and far-reaching).

42. Meteoriticists know that space bodies fall all over and each country is equally at risk. Michael Zolensky, *The Flux of Meteorites to Antarctica*, in METEORITES: FLUX WITH TIME AND IMPACT EFFECTS, at 93, 93 (Monica M. Grady et al., eds. 1998) [hereinafter METEORITE FLUX] (“Meteorites fall with equal frequency across all corners, nooks and crannies of the Earth.”). However, space experts do not know whether they will spot space bodies in advance of impact or how much damage will result. See *infra* notes 72, 75-76 and accompanying text (explaining the inherent imprecision of even the most advanced sighting equipment).

43. See *infra* Parts IV, V, and VI (recognizing general principles of international law that pertain to all megadisasters affecting multiple nations).

nations affirming the binding nature of shared duties to mitigate megadisasters. Part VII suggests ways in which nations can fulfill the duties identified in the prior sections.

II. THE SERIOUS THREAT OF EARTH COLLISIONS WITH SPACE BODIES

As is the case with other variations of exotic disasters, the dangers posed by a collision between comets or asteroids and the Earth grow with planners' corresponding lack of preparation in developing response measures. Part II.A first considers what scientists and historians know of the dangers posed by space bodies. Part II.B explains how the current delegation of decision-making authority to scientists inexperienced with matters of disaster response and law has created false hope. Consequently, scientists' incomplete response plans do not meet the requirements of true mitigation. In the face of continuing Earth bombardments by space objects, the international community must broaden the disaster planning process to include the expertise of practitioners of other disciplines, including and especially lawyers, who can construct frameworks for governing the responsibilities of all actors responding to multinational threats.

A. REASONS FOR CONCERN OVER THE DANGERS POSED BY EARTH IMPACTS

Even though collisions with space bodies could potentially extinguish all life on Earth, scientists were slow to appreciate the significance of the threat. Thousands of objects from space descend to our planet's *terra firma* each year.⁴⁴ Space bodies typically disintegrate before entering the Earth's atmosphere, which is protected by a "gaseous shroud" that annually withstands several interplanetary strikes.⁴⁵ But some projectiles can be so big and move so fast that the atmosphere cannot absorb their force, at which point damage occurs based on the size and velocity of the impacting object.⁴⁶ The destruction of the dinosaurs demonstrates the seriousness of asteroid or comet collision, as opposed to commonplace disasters.⁴⁷ Even if

44. See E.L. KRIVNOV, *GIANT METEORITES* ix (1966) ("Every year a large number, probably thousands, of meteorites in the form of iron and stone blocks fall to the Earth from interplanetary space."); Gerrard & Barber, *supra* note 17, at 7 (describing how "objects about ten meters across strike the Earth almost annually with an explosive force of about 10,000 tons of TNT (roughly the yield of the Hiroshima bomb)").

45. D. Steel, *Project Spaceguard: Will Humankind Go the Way of the Dinosaurs?*, 24 *IRISH ASTR. J.* 19, 21 (1997).

46. See Clark R. Chapman & David Morrison, *Impacts on the Earth by Asteroids and Comets: Assessing the Hazard*, 367 *NATURE* 33, 34 (1994) (discussing the importance of kinetic energy and the mass of impacting objects in determining whether they will collide with the Earth). In essence, "[t]he height of fragmentation depends primarily on the meteoroid's physical strength; only the strongest iron meteoroids reach the ground in one piece." *Id.*

47. Geologists have explored craters all over the world and agree that asteroid impacts have been responsible for species extinctions throughout the Earth's history, including dinosaurs. See generally Chapman & Morrison, *supra* note 46 (citing various studies showing mass

an impact would not cause the end of life, the resulting damage would be unlike any disaster the modern international community has seen. A serious collision could lead to the eventual "poisoning of the atmosphere through the production of various oxides of nitrogen . . . [and to] global fires, pyrotoxin production, giant tsunamis, earthquakes, severe greenhouse warming and acidic rain."⁴⁸ Even smaller objects (less than 2/3-mile or one kilometer in diameter) could cause damage equivalent to a nuclear detonation.⁴⁹

Successive civilizations have documented their experiences with asteroids and comets.⁵⁰ While space objects have been hailed as "stones from heaven,"⁵¹ many scientists doubted their existence.⁵² But soon after the publication of *On the Origin of Ironmasses* in 1794, popular sentiments changed when physicist Ernst Florens Chladni undertook a detailed investigation of several Earth impacts reported since ancient times and recognized, perhaps for the first time in that era,⁵³ the need to treat objects

extinctions of dinosaurs and applying these findings to a threat of human extinction); RENÉ GALLANT, *BOMBARDED EARTH: AN ESSAY ON THE GEOLOGICAL AND BIOLOGICAL EFFECTS OF HUGE METEORITE IMPACTS* 110-12 (1964) (observing several potential impact zones where "no doubt . . . the impact would have caused a world-wide catastrophe, with all the implied consequences"); Michael R. Rampino et al., *A Unified Theory of Impact Crises and Mass Extinctions: Quantitative Tests*, 822 ANNALS N.Y. ACAD. SCI. 403, 403-24 (1997) (using a mathematical model to suggest the linkage between "impacts of larger asteroids and comets with mass extinctions of life"). *But see* Gerta Keller, *Asteroid Impacts and Mass Extinctions—No Cause for Concern*, 822 ANNALS N.Y. ACAD. SCI. 399, 399 (1997) ("With the exception of the largest [space body crater] at the Cretaceous/Tertiary boundary, none are associated with significant biotic extinctions.").

48. Steel, *supra* note 45, at 23.

49. See Gerrard & Barber, *supra* note 17, at 7 (describing the potential Hiroshima-like blasts associated with asteroid or comet impacts).

50. See JOHN S. LEWIS, *RAIN OF IRON AND ICE: THE VERY REAL THREAT OF A COMET AND ASTEROID BOMBARDMENT* 10-29 (1996) (describing historical reactions to space bodies from across the globe); H.H. NININGER, *OUT OF THE SKY: AN INTRODUCTION TO METEORITICS* 4-12 (1959) (same).

51. See NININGER, *supra* note 50, at 4; *see also* KATHLEEN MARK, *METEORITE CRATERS* 1-2 (1987) (explaining how "meteorites have been found among relics of ancient societies in circumstances suggesting that they were revered, possibly even worshiped"). Arguably, the Bible refers to such phenomena. *See Acts* 19:35 (King James) (referring to an "image that fell down from Jupiter").

52. See MARK, *supra* note 51, at 1 ("In the eighteenth century the idea that stones or pieces of iron could fall from the sky was considered absurd by most European scientists."); *id.* at 5-6 (explaining how members of the Royal French Academy "discredited" accounts of fallen objects from space as "ordinary stone[s]" in the mid 1700s).

53. See generally ERNST FLORENS FRIEDRICH CHLADNI, *ÜBER DEN URSPRUNG DER VON PALLAS GEFUNDENEN UND ANDERER IHR ÄHNLICHER EISENMASSEN UND ÜBER EINIGE DAMIT IN VERBINDUNG STEHENDE NATURERSCHEINUNGEN* (Johann Friedrich Hartnoch of Riga 1794). Before this time, many doubted the phenomenon of Earth bombardment. Although Chinese historian Homer H. Dubbs later documented several citations to "deaths by 'meteors'" in the ancient annals of the former Han Dynasty, which existed between 89 B.C. and 25 A.D., *see* NININGER, *supra* note 50, at 4-5 (citing II HOMER H. DUBBS, *HISTORY OF THE FORMER HAN DYNASTY* BY PAN KU (1938)), early scientists easily dismissed those astronomical facts that they

falling from space more seriously.⁵⁴ Scientists soon realized that space bodies “do not simply land on Earth out of nowhere, make a crater, then lie around awaiting collection.”⁵⁵ They learned that space objects could kill.⁵⁶

Although most people have not witnessed the devastating effects of a large object from space impacting on Earth, a consistent chain of isolated incidents have alerted the public that such a threat is a possibility. June 30, 1908, 7:17 a.m., marked the last major event reported by living witnesses.⁵⁷ Within a matter of minutes, the largely unoccupied Tunguska region of central Siberia (which local people knew as a peaceful forest) had been transformed into a clearing of stripped and burning trees.⁵⁸ The damage was the result of the explosion in the air of a stone meteorite ranging from between fifty and sixty meters in length.⁵⁹ The force of the blast reached some persons as many as sixty kilometers away and threw others several meters from where they had been standing.⁶⁰ Years later, S.B. Semenov, an eye-witness to the cosmic spectacle, still recalled that morning:

I was sitting in the porch of the house . . . [W]hen suddenly in the north . . . the sky was split in two I felt great heat, as if my shirt had caught on fire. . . . [A]t that moment, there was a bang in the sky, and a mighty crash

could not objectively prove, demanding to witness the events with their own eyes. See MARK, *supra* note 51, at 1 (“It must be remembered that investigators were attempting to establish scientific truths about observation, and to distinguish fact from superstition; but even in the midst of such worthy intentions, preconceived notions about [the absurdity of asteroid impacts] were difficult to dislodge.”); NININGER, *supra* note 50, at 9-10 (describing so-called “authorities[’]” successful attempts to conceal and ignore evidence of asteroid impacts).

54. See Ursula B. Marvin, *The Meteorite of Ensisheim: 1492 to 1992*, 27 METEORITICS 28, 54 (1992), available at http://adsbit.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1992Metic 2728M (describing the far-reaching impact of Chladni’s research in developing an international awareness of Earth impact phenomena).

55. Monica M. Grady et al., *Meteorites: Their Flux with Time and Impact Effects*, in METEORITE FLUX, *supra* note 42, at 1, 2.

56. See LEWIS, *supra* note 50, at 176-82 (documenting approximately 10,038 fatalities that occurred due to space body collisions since 1420 B.C.).

57. This is not to discount the more recent experiences of bystanders like Michelle Knapp of Peekskill, New York, who was sitting at home in 1992 when a “crash . . . shook [her] house” as a twenty-seven pound meteorite fell from the sky and demolished her car. Clair Wood, *Earth’s Inevitable Collisions*, BANGOR DAILY NEWS (Bangor, Maine), Jun. 30, 1995, available at LEXIS, Nexis Library, News Group File. Fortunately for Ms. Knapp, the space specimen and the car fetched \$69,000 at an auction. *Id.* In fact, objects similar to the Peekskill meteorite created measurable devastation at least thirteen times on United States soil between 1911 and 1948. NININGER, *supra* note 50, at 12-35, 43-54.

58. See KRIVNOV, *supra* note 44, at 125-26 (describing significant physical damage to the Russian region).

59. For a description of the Tunguska meteorite, see generally Chris Chyba et al., *The 1908 Tunguska Explosion: Atmospheric Disruption of a Stony Asteroid*, 361 NATURE 40 (1993).

60. See KRIVNOV, *supra* note 44, at 125-265 (citing eye-witness testimonials and investigations of the occurrence).

was heard. I was thrown on to the ground about [twenty feet] away from the porch and for a moment I lost consciousness There was a thick forest there but I don't know where it has been taken.⁶¹

Could a similar disaster happen today in a more populated area? The answer is both clear and puzzling. Scientists are convinced that another asteroid or comet will strike the Earth, but they cannot say exactly when.⁶²

Aside from impacts resulting in actual damage, several close calls in recent times highlight the need for immediate and improved response measures. Even the last decade has not transpired without incident. In December 2000, an asteroid named 2000 YA passed within 480,000 miles of the Earth—a distance that astronomers called “a near miss in astronomical terms.”⁶³ If 2000 YA had collided with the Earth, the astronomers say, the projectile would have destroyed at least the city of London.⁶⁴ In July 1994, twenty-one fragments of the Shoemaker-Levy 9 Comet bombarded the planet Jupiter for over a week with such force that they darkened regions of Jupiter's atmosphere similar to or larger than the size of the Earth.⁶⁵ An impact of the same magnitude could have extinguished the human species. Thus, while space objects are not yet knocking on our door, they are definitely in our neighborhood.⁶⁶

61. *Id.* at 147-48 (internal quotations omitted).

62. See LEWIS, *supra* note 50, at 209 (figuring that an asteroid impact with the potential to kill one billion humans occurs four times each million years); Chapman & Morrison, *supra* note 46, at 37, 39 tbl.3 (estimating probabilities of a person's death resulting from an asteroid or comet strike ranging from one in 3000 to one in 20,000 to one in 250,000, based on the size of the space object and the predicted occurrence of its impact with the Earth); Gerrard & Barber, *supra* note 17, at 13 (calculating that “every person statistically has a one in one million chance of being killed by a comet or asteroid”); Steel, *supra* note 45, at 24 (predicting a one in 5000 chance of asteroid-related death).

63. *Space Rock Terror Flies By*, SUNDAY MERCURY (Birmingham, U.K.), Dec. 24, 2000, at 22, available at LEXIS, Nexis Library, News Group File.

64. *Id.* (explaining that the impact would have created a crater “twenty times its size” or “three quarters of a mile across”).

65. See Terence Dickinson, *Comet's Impact Spots Are Still Visible*, TORONTO STAR, Jul. 31, 1994, Sunday (final ed.), at E8, available at LEXIS, Nexis Library, News Group File (describing how “[f]our of [nine impact sites], known as G, H, K and L, are approximately the size of the Earth”).

66. Other recent cosmic close calls include an asteroid “the size of a small house” that “would have created a many kiloton explosion,” which ricocheted off of the Earth's atmosphere above Wyoming's Grand Teton National Park, Michael B. Lafferty, *Extinction Evidence Points Skyward: Massive Kill-offs Not Uncommon on Earth*, COLUMBUS DISPATCH (Columbus, Ohio), Dec. 27, 1992, at 6E, available at LEXIS, Nexis Library, News Group File, and an asteroid “the size of a two-car garage[,] weighing about 100 tonnes” that exploded over the Pacific Ocean in the vicinity of British Columbia. Terence Dickinson, *U.S. Air Force Aiming for Full Asteroid Alert*, TORONTO STAR, Aug. 4, 1996, Sunday (2d ed.), at F8, available at LEXIS, Nexis Library, News Group File. U.S. Air Force officials also confirmed that they had “recorded an average of nine

B. FAILURES IN THE DEVELOPMENT OF EARTH IMPACT MITIGATION PROTOCOLS

Although government agencies have developed and funded plans to mitigate threats posed by objects from space, these plans, by themselves, fail to demonstrate effective preparation. Astronomers are theoretically “mitigating” interplanetary collisions by tracking objects likely to come within the Earth’s orbit. Since at least 1998, the National Aeronautics and Space Administration (NASA) has charted the course of many hundreds of Near-Earth-Orbiting Objects (NEOs).⁶⁷ Other nations with available resources have also committed significant (though less) funding toward cataloguing threatening space objects using high-powered telescopes.⁶⁸ These efforts seem to convey a sense of commitment to global preparedness. Closer scrutiny, however, reveals a complete lack of disaster response measures to deal with post-sighting conditions.⁶⁹ Plans are confused by unresolved international law: who gets evacuated and in what order? Who distributes resources? Who controls the flow of refugees across borders? The questions are infinite because the threat is inestimable.⁷⁰ In many cases, scientists do not have the training or knowledge to provide useful guidance.⁷¹

atmospheric bursts a month since 1975, all from the entry of small asteroids” into the Earth’s atmosphere. *Id.*

67. NASA originally focused on approximately 2000 large asteroids (diameter > 1 km) that could orbit within a dangerous range of the Earth. *See generally* Steel, *supra* note 45, at 28 (explaining the focus of NASA and other asteroid tracking programs). NASA’s Spaceguard program is the most comprehensive of cataloguing efforts and is attempting to find “90% of the NEOs larger than 1 km diameter . . . before the end of 2008.” David Morrison, *Asteroid Comet Impact Hazards: NEO FAQ*, at <http://impact.arc.nasa.gov/introduction/faq-neo.html> (last visited Nov. 17, 2001).

68. *See* AMES SPACE SCI. DIV., NASA, SPACEGUARD SURVEY REPORT § 8.1, *available at* http://impact.arc.nasa.gov/reports/spaceguard/sg_8.html (describing the need for international coordination for the most effective alerting mechanism and reviewing a number of international efforts).

69. *See* Chapman et al., *supra* note 37, at 1:

[E]ssentially no analysis has been done of how to mitigate . . . repercussions from predictions of impacts (civil panic), how to plan for other kinds of mitigation besides deflection (e.g. evacuation of ground zero, storing up food in the case of a worldwide breakdown of agriculture, etc.), or how to coordinate responses to impact predictions among agencies within a single nation or among nations.

70. *See infra* note 74 and accompanying text (explaining the difficulty in predicting harm because so many space bodies strike without warning); *see also* NININGER, *supra* note 50, at 3:

Meteoritical phenomena are sufficiently rare that if it were left to a small especially trained group to make the observations and the reports for science, the records would be embarrassingly bare. Chance is the determining factor as to who shall see the important meteor . . . Instruction of the general public in the art of making the most useful observations on meteors . . . will go far in determining how frequently such knowledge as is accidentally acquired reaches the scientist.

71. *See* Chapman et al., *supra* note 37, at 15 (“A much broader segment of the . . .

Current efforts at cataloguing potential risks of Earth impacts also fail to address technological inadequacies that make post-sighting response measures a necessity. Notwithstanding tracking efforts, some asteroids and comets will elude technology because some space objects cannot be spotted.⁷² Even when sightings occur, response measures are limited because international law is unclear about the types of actions nations can take to defend themselves.⁷³ Moreover, limitations on the amount of time nations

community, beyond astronomers and space engineers [to include “the natural hazards community,” “experts in risk assessment,” “public officials,” and “chains of command in the military and law-enforcement/civil defense infrastructures”], needs to appreciate and become familiar with technical aspects of this hazard”). Understandably, and unfortunately, scientists have little time to consider social policy issues broader than their narrowly defined duties when reacting to space threats. See *NASA Skylab Reentry: Hearing Before a Subcomm. of the Comm. on Government Operations House of Representatives*, 96th Cong. 178 (1979) [hereinafter *Skylab Hearings*] (comments of Representative Walker, Member, House Comm. on Gov’t Operations and the Gov’t Activities and Transp. Subcomm.):

I find many times that in dealing with scientists and technicians, they forget the human element along the way. They get so wrapped up in the experimentation and in all of the things dealing with technology, they forget this. I found in dealing with them regarding the Three Mile Island nuclear problem that, while they were concerned with all the problems of a technological and scientific nature, they somehow forgot the human element—the people who were really concerned about it. They dealt in terms and subject matters that the public did not understand and that panicked them even further.

72. See Alan W. Harris, *Can We Defend Earth Against Impacts by Comets and Small Asteroids?* *MERCURY*, Nov./Dec. 1996, at 12 (“A common criticism of Spaceguard has been that it would leave a substantial fraction of the threat unanswered: the residual undiscovered asteroids, asteroids that might be discovered on a collision course [before the cataloguing process is complete] . . . smaller asteroids 0.1 to 1 kilometer in diameter, and long-period comets.”).

73. Although nations have an inherent right to self-defense, see U.N. CHARTER art. 51 (“Nothing in the present Charter shall impair the inherent right of individual or collective self-defense . . .”), use of nuclear weapons to destroy asteroids complicates matters. First, fallout from the explosion could endanger other nations. See Gerrard & Barber, *supra* note 17, at 9 (observing that nuclear weapons could actually “increase rather than decrease the destruction caused by impact” by creating additional threatening fragments). Second, many have questioned the legality of nuclear deployments in space under existing treaties. See Brooks, *supra* note 37, at 246 (discussing prohibitions on warhead deployment, which could limit the use of nuclear weaponry to defend against asteroid or comet threats). Aside from a nuclear solution, other plans to attach solar sails to asteroids or shoot gravity altering beams of energy to take them off course are poorly funded and hypothetical at best. Other “speculative” options besides nuclear arms include:

pulsed lasers; kinetic energy deflection (i.e., simply striking the asteroid with a massive projectile); mass drivers (devices that would be installed on the surface of the asteroid, quarry the rock, place it in buckets, and fling it into space in the right direction over a period of years); very large solar sails that would be affixed to the asteroid and capture solar radiation to exert pressure; and solar collectors that would capture sunlight on a curved primary mirror, focus it onto the surface of the asteroid causing the surface layers to vaporize, and thereby generating thrust.

require to effectively combat a probable strike make a nation's ability to spot an approaching space body far less important than a nation's ability to react to one.⁷⁴ Additionally, astronomers' impact predictions are fraught with error. Scientists twice startled the public in the last few years by predicting impacts within the next ten to forty years,⁷⁵ only to rescind both estimates after mere days had passed.⁷⁶

Without answering serious questions that perhaps only the law can resolve, governments will fail in their efforts to mitigate Earth collisions. The science of global preparation is plagued by imprecision, raising troubling questions about whether nations can effectively prepare for a threat they cannot accurately predict. Should they create new organizations, conduct extensive educational programs, or begin preparing evacuations on an international scale? Or, should they first wait for conclusive evidence that the Earth is in danger? Governments have thus far adopted the latter approach.⁷⁷ To date, efforts to "mitigate" asteroid or comet threats have amounted to nothing more than cataloguing objects in space. Because astronomers admit that certain space threats that can elude their current efforts could devastate the Earth within minutes, nations need to coordinate their efforts beyond mere stargazing.⁷⁸

The international community should endeavor to mitigate the threat of an asteroid or comet impact by allocating the proper resources to the task.

Gerrard & Barber, *supra* note 17, at 11.

74. See VIDEO, *supra* note 1 ("[T]oday, the most likely situation is zero warning. The next impact of a mile-sized object will probably happen without any prior discovery of it at all.") (comments of Dr. David Morrison); Steel, *supra* note 45, at 28 ("If there is . . . a large [asteroid] . . . due to hit the earth in (say) 23 years, then the chances are that we will not find it ahead of time. In fact we might not be aware of it until five or six seconds before it hits the ground.").

75. See Editorial, *Earth is Safe Again—For Now*, CHARLESTON POST & COURIER ED. (Charleston, S.C.), Nov. 8, 2000, at A14, available at LEXIS, Nexis Library, News Group File [hereinafter *Safe Earth*] (observing NASA's prediction on November 3, 2000 that a space object named 2000 SG344 would strike the Earth in 2030 and scientists similar comments of 1998 that a "mile-wide asteroid had a significant chance of hitting Earth in 2028").

76. *Id.*

77. Aside from international conferences on the subject and efforts to coordinate sky searches, countries have remained noncommittal in developing a global approach. See Brooks, *supra* note 37, at 241 ("There is at present no national or international project in place to deflect asteroids and comets. Whether or not any classified deflection plan exists is, of course, unknown."). And, while this danger is comparatively the most severe, governments prefer to limit their involvement in exploring options. Cf. Chapman & Morrison, *supra* note 46, at 39 ("[U]ntil a threatening body is actually found, we believe that preparation of a mitigation system would be premature and not cost-effective."); Leonard David, *Asteroid Impact Motto: Be Prepared*, at http://www.space.com/scienceastronomy/asteroid_defense_010309.html (Mar. 9, 2001) (quoting a discussion with Clark R. Chapman: "It's not like we need to establish a new federal agency for impact hazard preparedness.").

78. See *supra* note 77 (describing scientists' recommendations not to develop agencies to deal with asteroid impact disasters even in light of their observations of the seriousness of such threats).

Disaster response personnel and officials with the capacity to enact, carryout, and enforce binding legal obligations must be adequately trained and empowered. True mitigation requires plans to maintain communications in the event of an impact, to evacuate impact zones, and to institute proper response measures for guaranteeing human survival.⁷⁹ Without implementing these measures in a coordinated and collective manner, policymakers are confined to wishing on the stars, hoping that space bodies will miss the Earth or disintegrate as they approach the Earth's stratosphere.⁸⁰

III. OVERCOMING BARRIERS TO MITIGATION EFFORTS

Although the preceding section outlined reasons why nations must commit further resources to mitigating collisions of asteroids or comets with the Earth, several enigmatic issues must be resolved before developing an international response. Setting aside the need for an international law of transboundary disaster, which I explore in depth in Parts V and VI, three societal obstacles limit genuine consideration of the problem. First, the international community must abandon its indifferent attitude towards space risk.⁸¹ Second, it must rely on organizational responses that exceed the scope of current disaster response efforts.⁸² Third, and perhaps most important, it must develop legal imperatives that focus on shared responsibility rather than on allocating blame for the damages resulting from disasters.⁸³ After explaining the dynamics of each problem, I present possible solutions that should make such problems amenable to further resolution.

A. ABANDONING PUBLIC INDIFFERENCE TOWARDS OUTER SPACE RISKS

One impediment to an asteroid or comet disaster response system is the

79. See *supra* note 31 (explaining multiple activities that constitute mitigation efforts). Ensuring reliable communication is especially important because, no matter how advanced global networks may be, asteroid or comet impact debris could potentially disable the satellites orbiting above the Earth that provide such contact. See David, *supra* note 77 (explaining how particle debris, let alone a direct asteroid strike, might interfere with microelectronic circuitry in the satellites stationed in the geosynchronous orbit, "knock[ing] out, or severely disrupt[ing] global communications").

80. The topic of organizational governance is beyond the scope of this inquiry. Perhaps, the existence of organizations like the Scientific Committee on Antarctic Research (SCAR) or the Deep Sea-Bed Mining Authority provide a template for a future discussion on developing an international crisis-response organization. Both organizations have transformed in response to the conflicting needs, objectives, and concerns of nations with shared international responsibilities. See *infra* note 226 (discussing these collaborative efforts). This Note instead focuses on delineating shared international responsibilities and offers lawyers entrée into a discussion currently dominated by scientists with limited knowledge of the law.

81. See *infra* notes 84-96 and accompanying text (addressing this obstacle).

82. See *infra* notes 97-108 and accompanying text (exploring the dilemma).

83. See *infra* notes 109-19 and accompanying text (observing the extent of this limitation).

public's lack of concern about such threats. A common sentiment is: "Since we don't know of anyone who has died in this way, the chance that we could be killed in an asteroid impact is zero."⁸⁴ Bolstering this view is the Hollywood entertainment industry, which has overplayed the public's fears. Films like *Deep Impact*⁸⁵ and *Armageddon*,⁸⁶ which have greatly exaggerated the threats posed by space bodies, have caused many persons to question the risk involved in a collision with the Earth because it is the stuff thought to be mere science fiction. In other words, the public has found it difficult to distinguish science fiction from scientific fact.⁸⁷ Space may be so intangible to most people that they cannot relate the harm posed by space bodies to their own life experiences.

The indifference of the general public to matters relating to space has also influenced lawmakers. Many governmental bodies seem to be waiting for disasters to strike before explaining how the law of space operates. According to one commentator, in space, the "[l]aw hurries up after technology, trying to adjust its provisions to facts already occurred."⁸⁸ Such indifference is visible in the reluctance of Outer Space insurers to require spacecraft manufacturers and operators to adopt safety precautions when exploring space.⁸⁹ Here too, when faced with the potential for space-related

84. Steel, *supra* note 45, at 24. This argument has the same fallacious structure as, "Since I have never previously died, the chance that I will die is zero."

85. DEEP IMPACT (Paramount 1997) (portraying failed attempts to destroy asteroids, ultimately forcing the governments of the world to conduct lotteries for the selection of 1,000,000 humans to perpetuate the species in large caves fashioned after the biblical Noah's Ark); see also TYCUS (Paramount 1998) (developing a similar plot involving the creation of a "massive underground city" on Earth in preparation for a comet strike with the Moon).

86. ARMAGEDDON (Touchstone 1998) (involving an asteroid the size of Texas en route for a collision with the Earth).

87. See Chapman & Morrison, *supra* note 46, at 38 (describing the "lack of concern—even cynicism and incredulity that anyone should take the hazard seriously," because the hazard is an "extreme rarity"). Some of the apathy may also relate to reporters' humorous treatment of collisions. In one instance, editorialists compared the probability of an asteroid impact to the likelihood of "Bill Clinton to wed Monica Lewinsky" or "Michael and Latoya Jackson being the same person." Stephen White & Jo Merrett, Editorial, *Sept. 21, 2030: 500/1: It's the End of the World; Asteroid on Collision Course*, MIRROR (U.K.), Nov. 6, 2000, at 13, available at LEXIS, Nexis Library, News Group File. No doubt, astronomers' faulty predictions have also contributed to these mocking characterizations. See *Safe Earth*, *supra* note 75, at A14 (observing that "esteemed astronomers' troubling tendency to issue false alarms [about asteroid threats] undermines their credibility").

88. Maria de las Mercedes Esquivel de Cocca, *Is it Necessary to Redefine Principles and Concepts of the Outer Space Treaty?*, in FORTIETH COLLOQUIUM, *supra* note 38, at 84.

89. Pamela L. Meredith, *Spacecraft Failure-Related Litigation in the United States: Many Failures, But Few Suits*, in PROCEEDINGS OF THE THIRTY-EIGHTH COLLOQUIUM ON THE LAW OF OUTER SPACE 22, 23 (1995) (observing that "spacecraft losses simply have been accepted as the price of doing business in a high risk, high technology environment where standards for spacecraft quality control are still evolving"); cf. *Martin Marietta Corp. v. INTELSAT*, 763 F. Supp. 1327, 1333 (D. Md. 1991) (confirming that, in the "special context" of space missions, "public policy strongly favors enforcement of waivers of all tort claims," even though this is not the case in

disaster, policymakers have adopted the notion that "it won't happen to us."⁹⁰ Unlike the realm of astro insurance, however, the prevailing view that space law is so unique as to demand flexibility cannot overcome the magnitude of the risks posed by failing to act.⁹¹

Owing to the real danger posed by asteroids or other bodies from Outer Space, nations should implement systems to alert the public of impending transboundary disasters and should educate the public about ways to preserve life under such circumstances. In essence, nations commit themselves to respond in case of danger by treating the threats as real. Such a policy requires the development of guidelines to explain the obligations of the shared responsibility to respond to transboundary crises.⁹² With these doctrines must come oversight of those agencies responsible for such preparedness. Stricter regulations of warning procedures must apply to all organizations involved in sighting activities, with a uniform protocol for assessing the reliability of predictions and a uniform scale for determining the magnitude of the potential threats.⁹³

Closely related to the nation's commitment is the need to educate the public. This means educating and empowering citizens to develop individualized response plans. The citizens' knowledge of how to evacuate

other areas of law). For the implications of these regulatory oversights, see *infra* note 187 and accompanying text discussing the Skylab crisis, and *infra* note 113 and accompanying text discussing the fall of the Mir Space Station.

90. Chapman & Morrison, *supra* note 46, at 39.

91. See Barton Beebe, Note, *Law's Empire and the Final Frontier: Legalizing the Future in the Early Corpus Juris Spatialis*, 108 YALE L.J. 1737, 1764 (1999) (describing how space law moved toward the position advocated by Myres McDougal that policies should develop from "continued accretion" of our international experience, rather than a Hamurabic code (citing Myres S. McDougal & Leon Lipson, *Perspectives for a Law of Outer Space*, 52 AM. J. INT'L L. 407, 420 (1958))). These views conflict with Maxwell Cohen's idea that governments cannot risk being unprepared, as they might only have a single chance to address certain space-related issues. Maxwell Cohen, *Introduction: Law and Politics in Space*, in *LAW AND POLITICS IN SPACE* 11 (Maxwell Cohen ed., 1964). The idea of global disaster preparedness strikes quite a different note. In this case, no matter what the disaster may be, it is always better to plan ahead, even if one does not know the extent of a threat.

92. See JOVICA PATRNOGIC & BOSKO JAKOVLJEVIC, INT'L INST. OF HUMANITARIAN LAW, COLLECTION NO. 8, PROTECTION OF HUMAN BEINGS IN DISASTER SITUATIONS: A PROPOSAL FOR GUIDING PRINCIPLES 8, 9 (1989) (recognizing the importance of codified principles as a necessary coordinating tool).

93. While isolated agencies, such as the International Astronomical Union's Working Group on NEOs, have instituted preliminary recommendations to address the issue of hazard estimation, see Chapman et al., *supra* note 37, at 8 (describing international efforts to adopt a 72-hour peer-reviewed space body threat confirmation process and advocating the need to improve it), without a uniform process ensuring the validity of future predictions, diverging efforts at prediction could be of little help even if correct. Cf. (U.S.) PANEL ON THE PUBLIC POLICY IMPLICATIONS OF EARTHQUAKE PREDICTION, NATIONAL RESEARCH COUNCIL, EARTHQUAKE PREDICTION AND PUBLIC POLICY 57 (1975) [hereinafter EARTHQUAKE PREDICTION POLICY] ("A popular theme currently being espoused among some scientists and science popularizers is that 'prediction might be more devastating than the event itself.'").

heavily populated areas may determine to what extent a nation is harmed by a transboundary disaster. At present, persons entrusted with responding to disaster stress that people themselves make disasters happen by their own reactions to naturally occurring phenomena.⁹⁴ The veil of technology separating the general public from Outer Space threats—the “quick fix” to the problem of impact mitigation⁹⁵—may create more harm than good if nations do not make the effort to work with the public in the name of survival education.⁹⁶

B. RELYING ON ORGANIZATIONAL COORDINATION BEYOND THE SCOPE OF CURRENT DISASTER RESPONSE EFFORTS

A second obstacle to Earth impact mitigation is the natural tendency for disaster response planners to mistakenly believe that the approach used for dealing with localized threats will address harms stemming from megadisasters. Even in responding to commonplace crises, problems faced by current experts are mainly ones of coordination.⁹⁷ Several organizations commonly respond to a single disaster and often waste or misallocate their energies because they have different priorities.⁹⁸ Agencies can exhaust

94. See FRAZIER, *supra* note 13, at 14 (“In one important sense there is no such thing as natural disaster. A disaster is a social phenomenon. Across our planet for about four and a half billion years, the forces of nature have shaped, molded, and changed the earth.”); Denis Binder, *The Duty to Disclose Geologic Hazards in Real Estate Transactions*, 1 CHAP. L. REV. 13, 45 (1998) (explaining that “[t]here are no natural disasters [because] human activity invites the resulting tragedy . . .”).

95. See FRASIER, *supra* note 13, at 326-27 (describing criticisms of the view that technology becomes a mere “quick fix” to respond to disasters, when in fact it can be “counterproductive by increasing misplaced reliance”).

96. See EARTHQUAKE PREDICTION POLICY, *supra* note 93, at 103 (noting the “equal danger that hazard-reduction programs instituted by responsible public agencies may sometimes hurt some of the people while helping others”); SUANDRA K. SCHNEIDER, FLIRTING WITH DISASTER: PUBLIC MANAGEMENT IN CRISIS SITUATIONS 6 (1995) (“[T]he key to a successful governmental response depends on the extent to which postdisaster human behavior corresponds to prior governmental expectations and planning.”).

97. See John Kusler, *Impediments to Mitigation*, in ABA DISASTER SYMPOSIUM, *supra* note 31, at 2, 4 (“Coordination problems in relief and recovery efforts are common in both developing and developed nations with little definition of common long term mitigation goals by participating organizations.”).

98. See PATRNOGIC & JAKOVLJEVIC, *supra* note 92, at 8 (“[W]hen there is no proper and efficient coordination of action of so many participating actors . . . [t]he result is a waste of efforts and materials, duplication, and needs which are not satisfied while on the other hand there are surpluses.”). This inevitable problem of “multiorganizational suboptimality” exists in many collective public sector endeavors. DONALD CHISHOLM, COORDINATION WITHOUT HIERARCHY: INFORMAL STRUCTURES IN MULTIORGANIZATIONAL SYSTEMS 5 (1989). In these instances, “because each organization pursues its own goals, such a system permits the coexistence of incompatible goals, encourages the avoidance of responsibility, and involves costly duplication and overlap.” *Id.* As commentators note with respect to disaster response: “This problem of better coordination is a serious one, it should be tackled from the political, organizational and legal angles.” PATRNOGIC & JAKOVLJEVIC, *supra* note 92, at 8-9.

resources by the time victims most need them. Such losses are usually accepted as an implicit cost given the unpredictability of disasters.⁹⁹ Because the inadequacies of disaster response have not yet been felt on a grand scale where widespread crises affect multiple populations simultaneously, these difficulties have not received the criticism they deserve. The response to everyday natural hazards presents a misleading picture.¹⁰⁰ The unique disasters that comprise the focus of this Note demand coordinating activities at the international level. They require effective preplanning for effective mutual action, which, in turn, raises a number of important inquiries.

The greatest problem with disaster planning among cooperating agencies is that the plans they lay out have often become ends in themselves—having a plan in place takes priority over how well reasoned the plan is.¹⁰¹ In the case of high-magnitude threats, some critics may question whether people can plan effectively. On the one hand, there are few ways to test a plan that requires near total devastation before knowing whether it would work. The lack of predictability is simply much too great.¹⁰² On the other hand, assuming nations could develop means to achieve social stability and order in the aftermath of mass human annihilation, it can be questioned whether the survivors would need to preserve such systems that formerly existed. Put differently, there may be no use for a plan to preserve order in a society if the society no longer existed.¹⁰³

To solve the problem of misplaced reliance on the hope that routine responses to crisis will work effectively (or the related defeatist concern that

99. See BEVERLEY RAPHAEL, *WHEN DISASTER STRIKES: HOW INDIVIDUALS AND COMMUNITIES COPE WITH CATASTROPHE* 30 (1986) ("For the most part we do not know what disasters may await us or when they might occur. It is this lack of ability to know what, or when, that turns many natural or man-made occurrences into the truly disastrous catastrophes they become."); cf. David W. Sar, *Helping Hands: Aid for Natural Disaster Homeless vs. Aid for "Ordinary Homeless,"* 7 STAN. L. & POL'Y REV. 129, 139 (1995) ("[E]very type of disaster relief aid will be inefficient in some way because disaster relief does not occur in a competitive market.").

100. In other words, nations cannot afford to take a local approach. See IAN BURTON ET AL., *THE ENVIRONMENT AS HAZARD* 172 (1978) ("Because events on the higher end of the magnitude scale are exceedingly rare, the accumulation of experience can be enhanced if nations share their experience rather than continuing to rely on knowledge of rare events occurring within their own territories.").

101. See generally LEE CLARKE, *MISSION IMPROBABLE: USING FANTASY DOCUMENTS TO TAME DISASTER* 2 (1999) (noting, throughout his book, instances in which "organizations and experts use plans as forms of rhetoric, tools designed to convince audiences that they ought to believe what an organization says [when such] plans have so little instrumental utility in them that they warrant the label 'fantasy document'" (emphasis omitted)).

102. For example, many "[p]lans for recovery after general nuclear war are fantasy documents because the knowledge and experience necessary to know what would make for a realistic plan are unavailable." *Id.* at 14.

103. As Professor Clarke posits of the aftermath of nuclear warfare: "[T]he biggest question of all [is]: 'Would there be anything to return to?' By [planners'] own logic, the answer would be 'No.' If that were so, however, and if the overall society had been leveled in nuclear warfare, what, finally, would be the point of trying to defend against nuclear attack?" *Id.* at 93.

no measures could assist a civilization faced with utter annihilation), nations should adopt a collaborative dual/all-hazards civil defense approach to megadisaster. This approach requires three steps. First, planners should embrace Professor Jeremy Waldron's view of "fall-back" rights as the guiding principles for megadisaster mitigation planning.¹⁰⁴ This notion asserts that the delineation of rights and duties to deal with a total breakdown in relationships that people rarely question promotes efficiency and stability in the normal course of such relationships, even when danger is not imminent.¹⁰⁵ Second, planners should adopt an outlook similar to one instituted in the 1970s by the directors of civil defense programs to address nuclear attacks. This perspective allowed for planning even under uncertain conditions.¹⁰⁶ Finally, developed nations should recognize the value of the

104. Jeremy Waldron, *When Justice Replaces Affection: The Need for Rights*, 11 HARV. J.L. & PUB. POL'Y 625, 629 (1998) ("The structure of rights is not constitutive of social life, but instead to be understood as a position of fall-back and security in case other constituent elements of social relations ever come apart.").

105. For example, Professor Waldron points to the European Convention on Human Rights: "No one shall be subjected to torture or to inhuman or degrading treatment or punishment." *Id.* at 643 (quoting European Convention for the Protection of Human Rights and Fundamental Freedoms, art. 3, Nov. 4, 1950, 213 U.N.T.S. 221 (entered into force Sept. 3, 1953), reprinted in ARTHUR HENRY ROBERTSON, HUMAN RIGHTS IN EUROPE 294-95 (1977)). On a theory of fall-back rights, while "in ordinary political arrangements between state and citizen, the issue of torture simply does not arise . . . people need this as something to fall back on when normal politics collapse." Waldron, *supra* note 104, at 643. Having the rights and duties in place, in fact, drives society in new directions and "provide[s] a dynamic for social progress by challenging the existing types of relationships with new ones." *Id.* at 631.

106. See CLARKE, *supra* note 101, at 95 ("The years 1974 through 1976 . . . saw the development of the last major element of full-spectrum preparedness—contingency planning to relocate (evacuate) people from U.S. metropolitan areas and other risk areas during a period of several international crises."). Attainment of realistic planning objectives involved drawing analogies to disasters that the world had experienced and projecting not one, but chains of successive catastrophes. See *id.* at 93 ("While it is not necessary to argue that nuclear war is some sort of everyday affair, it is necessary to argue that it is sufficiently like something that we know as to lend itself to operational rationality." *Id.* at 93 (emphasis in original)). Hence, the birth of "dual-or all-hazards planning," or marshalling the same resources used to combat the devastation of natural disasters with nuclear ones. *Id.* at 94. Officials observed the spill-over effects of these multipurpose efforts:

Civil defense readiness generates, as a bonus, an improved capability on the part of a State or local government to conduct coordinated operations in the event of peacetime emergencies. If State and local governments are prepared to deal with the worst of all possible situations—a nuclear emergency [and, in this case, a severe asteroid impact]—it is a reasonable assumption that these governments can handle lesser emergencies—hurricanes, floods, etc.—effectively and efficiently. But, should a State or local government turn a blind eye to the nuclear attack aspect of civil preparedness [or, in this case, severe asteroid impact], its ability to respond to a lesser disaster becomes questionable.

James R. Schlesinger, *Civil Defense Programs: Roles and Missions*, FORESIGHT, Jan.-Feb. 1975, at 2-3. And, just as in the case of planning for nuclear war, in the case of planning for an asteroid or comet impact, it is reasonable to fathom survivors who will need a set of rehabilitative

experience of less developed nations in overcoming natural disasters. That should lessen the fear that only the more developed nations should be included in plans to mitigate serious natural threats.¹⁰⁷ This final consideration should help alleviate doubts that economic disparity prevents all hopes of an effective multinational effort.¹⁰⁸

C. *REJECTING BLAME ALLOCATION AS THE MEANS TO ESTABLISH INTERNATIONAL DUTIES*

The third obstacle limiting successful mitigation of transboundary megadisaster is the overarching reliance on the principles of blame and culpability in resolving matters concerning international obligations. In areas less abstract than space, nations have had difficulty delineating their individual responsibilities, even though they recognize their mutual duties.¹⁰⁹ Aside from the fact that all nations cannot equally contribute resources in the mitigation of disasters, the lopsided development of disaster law makes it questionable whether nations have obligations to assist one another before disaster strikes. Complex systems for delineating responsibility for man-made disasters already exist,¹¹⁰ while the law dealing

guidelines—if not to perpetuate their respective nations, then the survival of their species. In the aftermath of huge disasters, “[t]here is recovery from even the worst of earthquakes. There is a place to go to even in the biggest of fires—because you could go to another city until yours is rebuilt. The all-clear will eventually be sounded. There will be life after catastrophe.” CLARKE, *supra* note 101, at 96 (emphasis in original).

107. Because “[t]he most highly organized preparation exists in communities and societies that have repeatedly and recently experienced . . . disaster,” FRAZIER, *supra* note 13, at 340 (citation omitted), developed nations can learn from even the third-world. See PLAN FOR THE NATION, *supra* note 32, at 24-25 (“As a world leader, the United States cannot afford to focus its efforts on disaster reduction on a domestic scale only; it must continue to take a global approach Continuing [international] cooperation will enable the United States to learn from the experience and expertise of other nations.”).

108. See *supra* note 35 (describing traditional problems like fears of free-riding by less developed nations that have prevented developed nations from including all countries in their international efforts). In this regard, shared experience presents a source of human capital that can increase the value of collaborative efforts. Such was the case, for example, in the United States government’s joint efforts in the U.S./Mexico Project on Hydrometeorological Phenomena in the Brownsville/Matamoros. See generally Richard W. Krimm, *Transferring Mitigation Techniques Between Developed and Developing Nations*, in ABA DISASTER SYMPOSIUM, *supra* note 31, at 32-33 (describing how the development of six working groups allowed for successful dissemination and sharing of disaster mitigation strategies).

109. For example, although the international courts have procedures to assess monetary damages, high burdens of proof of causation make dispute resolution nearly impossible. See Devereaux F. McClatchey, *Chernobyl and Sandoz One Decade Later: The Evolution of State Responsibility for International Disasters, 1986-1996*, 25 GA. J. INT’L & COMP. L. 659, 675-76 (1996) (explaining how tort law has failed to settle legal disputes over nuclear disaster due to the difficulty of proving causation scientifically).

110. See M.F. Lechat, *The International Decade for Natural Disaster Reduction: Background and Objectives*, 14 DISASTERS 1, 3 (1990) (noting “specific” measures to deal with man-made disasters but pointing out the problems facing planners posed by unpredictable natural disasters).

with asteroid or comet impact is largely undefined and hypothetical. The byproduct of this uneven development is a toolbox of reactive rather than proactive methods—tools that work better to address man-made problems because they focus almost entirely on blame and culpability.

By waiting until disaster occurs before acting, courts and governments depend entirely on blame to resolve international controversies. Though it is possible to assign blame for oil spills and the misuse of energy sources,¹¹¹ nations cannot easily assign blame for a tsunami or an earthquake.¹¹² While the economic market suggests an alternative for compensating losses in the latter cases (e.g., providing insurance protection against earthquake damage),¹¹³ in the case of collisions with large space bodies, the private sector would be helpless to intervene. There may be no economic remedy for damages caused by a crisis so massive.¹¹⁴ Additionally, large-scale disasters would force countries to mobilize expensive technologies that would be unavailable to private entities.¹¹⁵

Notwithstanding the drawbacks of employing a system depending on the determination of culpability, one might expect that blame-oriented approaches—by deterring negligence—would force nations to recognize their mutual responsibilities. But courts are often helpless to do so, even when addressing States' moral and financial obligations related to man-made disasters.¹¹⁶ Efforts to enforce international environmental

111. See McClatchey, *supra* note 109, at 677-78 (discussing how strict liability and negligence standards can achieve the goal of compensation for man-made disasters).

112. See CHRISTOPHER D. STONE, *Should We Establish a Guardian for Future Generations?, in SHOULD TREES HAVE STANDING AND OTHER ESSAYS ON LAW, MORALS, AND THE ENVIRONMENT* 65, 80 n.25 (1996) [hereinafter ENVIRONMENTAL ESSAYS] (noting that mitigation of an asteroid threat "would be . . . distinct in the way we would be eliminating a peril we did not cause (the way in which we 'cause' toxic wastes)"). In fact, courts often refer to asteroid impacts as "acts of God," an entity from which recovery is quite unlikely. See *Am. Home Assurance Co. v. J.F. Shea Co.*, 445 F. Supp. 365, 368 (D.D.C. 1978) (observing that a "falling meteorite" or an "outside force, such as an explosion [or] earthquake" is beyond the control of mankind).

113. For example, the Russian government's first step in dealing with the Mir Space Station's fall back to Earth was to insure itself against liability for \$200 million. See Editorial, *Mir Headed for Crash into the Ocean*, HOUSTON CHRON., Mar. 22, 2001, at YO7, available at LEXIS, Nexis Library, News Group File (suggesting that Russia's act of obtaining \$200 million in liability insurance was "perhaps most telling" of the seriousness of the event).

114. Cf. EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY 71 (The United Nations University 1989) (1988) ("Long-term damage to people, particularly to children, from exposure to radiation and to [contaminated] soils and ecosystems remains unclear and will never be fully compensated.").

115. See UNITED NATIONS, THIRD UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE, DISASTER PREDICTION WARNING AND MITIGATION: BACKGROUND PAPER 2, U.N. Doc. A/CONF.184/BP2 11-13 (1998) (describing a number of international emergency communications systems that mainly require coordinated efforts with governmental entities in order to function). These measures show that victims of a mass disaster must depend upon highly-trained government entities to mobilize life-preserving resources.

116. See *Tanner v. ARMCOR Steel Corp.*, 340 F. Supp. 532, 536-37 (S.D. Tex. 1972) (refusing

responsibilities are likewise hopeless because such international organizations as the United Nations rarely institute measures that compel compliance,¹¹⁷ and courts frequently cannot determine precisely the economic costs of the harm.¹¹⁸ Because remedial action depends upon the damage incurred in particular instances, nations would not know what liability to expect until actual damage results. Such uncertainty paralyzes international cooperative efforts to plan effectively for large-scale disasters.

Solving this problem of misplaced reliance requires no more than the realization that anticipatory action is the workable method of mitigating impacts with space bodies and similar types of megadisasters. To make any sense of the duty to mitigate global catastrophes, the international legal system must promote the idea that preventive and anticipatory action—cooperating for the reduction of serious international threats before they occur—is the only way that sovereign, but dependent, nations can reduce or prevent resulting damage.¹¹⁹ Remaining true to the principle of anticipatory action should avoid many questions that stem from the *ex post* determinations required to assign blame. To make this shift requires the recognition of international duties to cooperate, warn, and mitigate threats. It also requires the creation of a new international body through which to

to recognize environmental rights because “from an institutional viewpoint, the judicial process, through constitutional litigation, is peculiarly ill-suited to solving problems of environmental control” and because “the inevitable trade-off between economic and ecological values presents a subject matter which is inherently political and which is far too serious to relegate to the ad hoc process of ‘government by lawsuit’ in the midst of a statutory vacuum”); McClatchey, *supra* note 109, at 663-64 (describing the reluctance of the Soviet Union to deal with the international damage caused by Chernobyl because of ill-suited legal structures); Larry E. Potter et al., *Encouraging Proenvironmental Behavior: The Environmental Court as a Contingency Manager*, 27 ENV'T & BEHAV. 196, 197-98 (1995) (illustrating how punitive blame-based systems undermine environmental protection by creating “contingency relationships” where organizations benefit more by violating the law and detailing how a court must shift from its normal role in criminal matters, often inducing inspectors and the scientific enforcement community to lose confidence in the courts).

117. See Linda A. Malone, “Green Helmets”: A Conceptual Framework for Security Council Authority in Environmental Emergencies, 17 MICH. J. INT’L L. 515, 519 (1996) (noting the lack of internationally organized task forces to respond to environmental emergencies, even though thirteen countries have proposed creating forces wearing green helmets to signify environmental enforcement, resembling the blue helmets adorned by United Nations peacekeeping forces).

118. See McClatchey, *supra* note 109, at 673 (noting that “while international law concerning environmental disasters has progressed rapidly . . . it has remained stubbornly static in the area of liability for transboundary harm” and listing a number of treaties that “sidestep” the issue of calculating damages).

119. Chernobyl teaches an important lesson because the world had to see the horrors of a nuclear calamity first-hand before it understood the need for preventive measures, including legal rules. See *generally id.* (reviewing the development of transnational disaster law). Adopting the same approach with respect to asteroid threats presumes that people will leave ground zero having learned their lessons about future preparation, just as they did in the aftermath of Chernobyl. Furthermore, this decisional model ignores the fact that Chernobyl’s devastation pales in comparison to even a minimal asteroid impact the likes of Tunguska.

coordinate efforts to reduce the effects of more irregular transboundary threats.

IV. LEGAL FRAMEWORK

Even with preliminary solutions to overcome the obstacles preventing Earth impact mitigation, it is necessary to define the extent of nations' rights and obligations in the mitigation process.¹²⁰ Delineating international responsibility requires the consideration of the sources of international law. Nearly every work on the subject raises three potential candidates as the foundation upon which legally binding obligations are built: treaties, customary international law, or general principles of international law.¹²¹ There is some concern over which of these sources should take priority.¹²² Therefore, Part IV briefly explores the reasons why general principles of international law—rather than other sources of law—are especially relevant in attempting to resolve the legal questions underlying obligations to mitigate collisions between space bodies and the Earth.

Treaties are perhaps the most compelling source of law because they indicate when nations have assumed binding legal obligations.¹²³ International law recognizes the weight of treaties in the principle of *pacta sunt servanda* (that “[e]very treaty in force is binding upon the parties to it and must be performed by them in good faith”¹²⁴). While there are treaties that address the responsibility of nations to aid astronauts in distress or warn

120. This assertion, of course, presumes that States will comply with binding obligations, which is a valid concern given the sources addressed *supra* note 38, which explore doubts about the extent and enforceability of international law. However, I refer to my discussions *infra* Part VII to explain my faith in States' willingness to comply with principles of cooperation in mitigating such disaster.

121. One of the foremost authorities on the sources of international law is the Statute of the International Court of Justice, Jun. 26, 1945, art. 38(1)(a)-(d), 59 Stat. 1055, 1060, 33 U.N.T.S. 993 (annexed to Charter of United Nations and forming an “integral part” of the Charter) (defining “international conventions,” “international custom,” and “the general principles of law recognized by civilized nations” as the preeminent sources of international law).

122. See MALCOM N. SHAW, INTERNATIONAL LAW 96 (4th ed. 1997) (“There is a principle to the effect that a special rule prevails over a general rule (*lex specialis derogat legi generali*), so that, for example, treaty rules between states as *lex specialis* would have priority as against general rules of customary law between the same states.”); *id.* at 97 (explaining the “hostile attitude of many states to general principles as an independent source of international law”); Jose E. Alvarez, *Positivism Regained, Nihilism Postponed*, 15 MICH J. INT'L L. 747, 757 (1994) (reviewing G.M. DANILENKO, LAW-MAKING IN THE INTERNATIONAL COMMUNITY (1993) and summarizing the argument that a general principle of law “is nearly void for vagueness and contains so few examples that it probably can be ignored or reduced to mere subsidiary evidence of law, like the writings of scholars”).

123. See *supra* note 39 and accompanying text (describing nations' deference to their voluntarily assumed responsibilities).

124. Vienna Convention on the Law of Treaties, May 23, 1969, art. 26, 1155 U.N.T.S. 331, 339, 8 I.L.M. 679, 690.

each other of impending danger when exploring or using Outer Space,¹²⁵ none of these treaties have yet addressed the question of a collision between space bodies and the Earth.¹²⁶ While such treaties may very well direct a nation that spots an approaching asteroid or comet to warn others, the problem with relying on a treaty-based duty to give warning is that warnings presume the actual notice of an impending threat. This is hardly the case in all major asteroid or comet collisions.¹²⁷ Furthermore, effective planning would require further delineation of duties to combat the extreme devastation caused by an impact.¹²⁸

Customary international law also encompasses duties extending beyond the limits of the explicit wording of treaties. So long as countries manifest their commitments to a certain practice in their relations with other nations, duties to comply with the course of former performance may very well exist with the same force of law as a treaty-based obligation.¹²⁹ In *The Paquete Habana* case,¹³⁰ for example, the United States Supreme Court held that, as long as a custom could be established through historical international practice, "international law is part of our law."¹³¹ Yet, a customary international duty to collaborate in response to Earth collisions would require prior international commitments specifically to react to these threats. As Part II.B explained, the lack of historical commitment among scientists to treat such threats seriously raises questions about whether cataloguing efforts are so historically entrenched as to constitute binding obligations among nations.¹³² Because most nations are noncommittal as to their obligation to respond to Earth collisions, customary international law,

125. For an example of such a treaty, see *infra* note 204 and accompanying text, which discusses relevant provisions of the Outer Space Treaty.

126. See Brooks, *supra* note 37, at 248 (posing unanswered questions about States' obligations to respond to Earth collisions).

127. See *supra* note 74 (describing the unpredictability of asteroid or comet collisions with Earth and the possibility that an approaching space body may be overlooked).

128. See *supra* note 31 (defining multiple aspects of natural disaster mitigation).

129. Customary international law involves two major factors. For an obligation to be binding, all countries must first subscribe to a rule of law, even though it is not directly stated in a treaty. See 1 LASSA OPPENHEIM, INTERNATIONAL LAW: A TREATISE 26 (H. Lauterpacht ed., 8th ed. 1955) ("International jurists speak of a *custom* when a clear and continuous habit of doing certain actions has grown up under the aegis of the conviction that these actions are, according to International Law, obligatory or right.") (emphasis in original). Second, these countries must demonstrate, through their actions, that they are voluntarily adhering to the law rather than simply recognizing it symbolically as a matter of diplomacy. See RESTATEMENT (THIRD) OF FOREIGN RELATIONS LAW OF THE UNITED STATES § 102(2) (1987) (requiring the demonstration of an actual "sense of legal obligation" or *opinio juris sive necessitatis* on the part of States subscribing to a practice).

130. 175 U.S. 677 (1900).

131. *Id.* at 700.

132. See *supra* note 77 (discussing planners' disinterest in creating an organizational response).

in all probability, would prove an ineffective tool.¹³³

General principles of international law operate differently from treaties or customs in that they “belong to no particular system of law, but are common to them all.”¹³⁴ They exist as gap-fillers to help prevent cases in which international courts cannot resolve a disputed issue.¹³⁵ The key feature of this source of international law is its focus on national practices that collectively indicate obligations to fulfill certain duties. Examples of general principles include the duty to negotiate in good faith and the concept of estoppel.¹³⁶ This source of binding international law accommodates the multiple practices within and between states adhering to a principle of cooperative preservation. In order to establish a general duty to prevent Earth impact collision, nations must adopt practices aimed at ensuring survival and further commit themselves to participate collectively in achieving this objective.

V. THE HISTORICALLY ENTRENCHED RIGHT TO GLOBAL SURVIVAL

The legal approaches below rest on a principle requiring global cooperation for the preservation of individual nations within a collective disaster response effort (hereinafter cooperative preservation). At the most basic level, all nations are bound to a well-recognized duty of self-preservation.¹³⁷ Cooperative preservation extends this duty by recognizing that some threats are so significant as to require a nation to participate in a group addressing the problem before it can successfully fulfill its obligation of self-preservation.¹³⁸ By this token, if preplanning is the only way to limit harm to a nation—and, by virtue of such necessities as massive international evacuation, the nation is forced to cooperate with other nations—the duty to collaborate trumps the sovereign right to limit joint mitigation efforts.

A. THE DUTY OF SELF-PRESERVATION

International mitigation of an asteroid or comet impact depends on the existence of a global right to survival and the correlative international duty

133. See *supra* note 37 (posing a number of unanswered questions about the responsibilities of nations in responding to an Earth impact crisis).

134. BIN CHENG, *GENERAL PRINCIPLES OF LAW AS APPLIED BY INTERNATIONAL COURTS AND TRIBUNALS* 390 (1953).

135. See SHAW, *supra* note 122, at 78 (explaining that general principles are necessary to prevent the *non liquet* or legal issue that cannot be resolved by international courts: “[W]hile there may not always be an immediate and obvious rule applicable to every international situation, ‘every international situation is capable of being determined as a matter of law’”) (citation omitted).

136. See *id.* at 80-81 (citing cases).

137. See *infra* notes 139-40, 161-67 and accompanying text (explaining this long-established duty).

138. See *infra* notes 168-79 and accompanying text (recognizing ways in which the duty extends to international cooperation).

of nations to enforce that right. At the most basic level, two components serve as building blocks for this right. First, nations must recognize their active roles in intervening to protect their citizens. Early jurists, such as Vattel, codified the principle of international law underlying this duty:

The *end* or *object* of civil society is to procure for the citizens whatever they stand in need of for the necessities, the conveniences, the accommodation of life, and, in general, whatever constitutes happiness,—with the peaceful possession of property, a method of obtaining justice with security, and, finally, a mutual defense against all external violence. . . .

In the act of association, by virtue of which a multitude of men form together a state or nation, each individual has entered into engagements with all, to promote the general welfare; and all have entered into engagements with each individual, to facilitate for him the means of supplying his necessities, and to protect and defend him. It is manifest that these reciprocal engagements can not otherwise be fulfilled than by maintaining the political association. The entire nation is then obliged to maintain that association; and as their preservation depends on its continuance, it thence follows that every nation is obliged to perform the duty of self-preservation.¹³⁹

This right is not negative in nature, but positive.¹⁴⁰ In other words, the government is not obligated strictly by morality, but, rather, by the need to sustain itself, which guarantees the existence of its sovereignty.

Second, nations must cooperate with other nations in order to fulfill the duty of self-preservation. Using Earth collision as the test case, because the threat is unpredictable and can likely harm more than one nation, it stands to reason that States must develop contingencies together and share certain

139. EMERICH DE VATTEL, *THE LAW OF NATIONS OR PRINCIPLES OF THE LAW OF NATURE, APPLIED TO THE CONDUCT AND AFFAIRS OF NATIONS AND SOVEREIGNS* 4 (Joseph Chitty ed., 1876) (1758); see *id.* at 5 (“[C]ivil society is so useful, nay so necessary to all citizens, that it may well be considered as morally impossible for them to consent unanimously to break it without necessity . . . [I]n general, as long as the political society subsists, the whole nation is obliged to endeavour to maintain it.”); *id.* (“If a nation is obliged to preserve itself, it is no less obliged carefully to preserve all its members.”). For a detailed exploration of the principle of self-preservation as applied to territorial matters, see CHENG, *supra* note 134, at 32-68 (reviewing cases).

140. See Penny Lewis, *Rights Disclosure and Assisted Suicide*, 27 AM. J.L. & MED. 45, 50 (2001) (explaining that a negative right constitutes a right to “non-interference,” whereby “others have a duty not to interfere with the individual’s [choices],” while a positive right or “welfare right” means that “others have a duty to assist the individual [in need]”).

resources before the threat materializes in order to reduce the threat to their own people. This is true especially because space bodies have the potential to force the evacuation of entire nations.¹⁴¹

Views are likely to diverge on this point. Some observers will definitely see the precommitment of resources to a cooperative preservation effort as meeting their own duty to maintain sovereignty. However, others might see such commitments as reducing their sovereignty, assured that they should alone decide the amount of resources, if any, to commit and the degree to which they should cooperate.¹⁴² Although total disregard for the reality of an imminent threat would violate their duty of self-preservation,¹⁴³ nations inevitably will refuse collaborative efforts without first articulating their rationales.¹⁴⁴ The more desirable position reasons that cooperation must follow because the global power to govern hinges on the right of sovereign nations to survive, which in turn hinges on the right of individuals to survive.¹⁴⁵ To achieve this position, Part V.B adopts a historical approach that places both elements of the duty of cooperative preservation (i.e., individual and collective self-preservation) in context, explaining why historical practice would not violate customary international law pertaining to, and distinguishing historical duties from, newer types of entitlements.

B. SELF-PRESERVATION AS DISTINCT FROM NEWER AND MORE ABSTRACT RIGHTS TO THE ENVIRONMENT

To understand how the duty of cooperative preservation unfolds,

141. See *supra* notes 1, 44, 47-49, 64 and accompanying text (explaining that environmental devastation can be so severe that massive relocations might be the only way to preserve States' continued functioning).

142. In isolation, certain general principles of international law seem to favor this view. See CHENG, *supra* note 134, at 67 ("With regard to international obligations, the right of the State to adopt measures necessary to ensure the welfare and security of the community in exceptional circumstances cannot be considered as being impaired by general provisions contained in treaties entered into with reference to normal circumstances."). Yet, even on this view, principles of necessity may still contravene the right to close off borders to other nations in need. See *id.* at 69-102 (exploring this principle).

143. See John C. Kunich, *Planetary Defense: The Legality of Global Survival*, 41 A.F. L. REV. 119, 126 (1997) ("To do nothing [in the event of an asteroid threat] is to abdicate our duty to defend the United States, and indeed the entire world, and place our very survival in the uncertain hands of the false god of probabilities.").

144. See *supra* note 39 and accompanying discussion (explaining the general assumption that nations do act on legal commitments of which they are aware and to which they acquiesce).

145. These assumptions rely on the notion that individual and collective rights are inextricably linked. See Jennifer A. Downs, *A Healthy and Ecologically Balanced Environment: An Argument for a Third Generation Right*, 3 DUKE J. COMP. & INT'L L. 351, 366 (1993) (noting that "first and second generation rights have collective aspects, and therefore any theoretical framework loathe to accommodate collective elements was subverted long ago") (referring to Louis B. Sohn, *The New International Law: Protections of the Rights of Individuals Rather than States*, 32 AM. U. L. REV. 1, 48 (1982) ("[T]he effective exercise of a collective right is a precondition to the exercise of other rights.")).

lawmakers must distinguish the historical right to survive from the subset of more abstract environmental rights. Here, nations' historical compliance upholding certain survival-based duties reveals their binding nature, as opposed to impotent rights, which have only recently been recognized.¹⁴⁶ Scholars often refer to this less virile strand of entitlements with the all-encompassing term "right to environment."¹⁴⁷ They concede the importance of basic needs for survival,¹⁴⁸ but fail to recognize the codification of such principles before the 1960s,¹⁴⁹ or more "recent years."¹⁵⁰ In effect, they deny ancient rights to survival by saying that the right to environment emerged in the last few decades. The right to survival described here does not refer to modern holistic notions that seek to maximize all aspects of an individual's physical, psychological, and spiritual well being.¹⁵¹ Instead, I limit the concept to the bare essentials required for human subsistence. Most recognize these entitlements as the right to "have air to breathe, water to drink, food to eat, and a place in which to live and sleep."¹⁵² In essence, these rights pertain only to the natural resources necessary for human survival. Consequently, they constitute the foundation upon which other rights are built.¹⁵³ Or, stated differently, "Survival, the most fundamental

146. Some identify this ecological cluster of rights as "adjectives [that] include: decent, healthful, natural, pure, clean, ecologically-balanced, and safe [environments]." Melissa Thorne, *Establishing Environment as a Human Right*, 19 DENV. J. INT'L L. & POL'Y 301, 309 (1991).

147. *Id.*

148. See DIANA T. MEYERS, *INALIENABLE RIGHTS: A DEFENSE* 1 (1985) (noting that, while some natural rights theories are questionable, "the fundamental normative load carried by natural rights—that persons ought to be guaranteed a core of personal security and autonomy—is almost irresistible"); Larry Rasmussen, *Human Environmental Rights and/or Biotic Rights*, in RELIGION AND HUMAN RIGHTS: COMPETING CLAIMS? 36, 39 (Carrie Gutafson & Peter Juviler eds., 1999) (noting that "[e]cocide is homicide").

149. See Thorne, *supra* note 146, at 303 (observing that "the idea of environment as a human right first emerged in the international arena in 1968 when the General Assembly of the United Nations recognized that technological changes could threaten the fundamental rights of human beings").

150. David A. Wirth, *The Rio Declaration on Environment and Development: Two Steps Forward and One Back or Vice Versa?*, 29 GA. L. REV. 599, 616 (1995) (explaining the modern trend to recognize an "individual right to environment"); Paul Gormley, *The Legal Obligation of the International Community to Guarantee a Pure and Decent Environment: The Expansion of Human Rights Norms*, 3 GEO. INT'L ENVTL. L. REV. 85, 85 (1990) ("The right of private individuals to be guaranteed a decent and safe environment is one of the newer rubrics of human rights law that has been recognized since the 1970s.").

151. See Thorne, *supra* note 146, at 309 (defining a number of abstract environmental rights). Each of these characterizations is relative and can be defined according to different societal standards of living. The basic rights to which I am referring apply uniformly to all societies.

152. *Id.* at 301 (noting additionally that "[i]f these elements become polluted, contaminated, or are eliminated or destroyed, life will cease to exist").

'common interest' of humanity, underlies all legal and social systems."¹⁵⁴

Without recognizing codifications of the ancient right to survival, nations will not achieve cooperative preservation. The first result of an emphasis on modern rights,¹⁵⁵ as opposed to historical ones, is the belief that rights to the environment are still developing, owing to their relative youth and that they require gradual development before gaining acceptance as customary international law.¹⁵⁶ This view may also appear to violate existing customary international law.¹⁵⁷ Namely, to rely on the more modern categorization of environmental rights recognizes that "[t]here is no legal tradition in our system that recognizes rights to nature preservation . . . [and] there is no historical experience on which to draw to give consent to an asserted ecological right."¹⁵⁸ The second result is heightened attention to current ideological differences between nations that favor isolationism and ignore historical compromises that resulted in joint mitigation efforts.¹⁵⁹ By recognizing the timeless applicability of the duty of cooperative preservation, nations can develop a framework for its immediate enforcement in dealing with threats posed by space bodies.¹⁶⁰

To begin, the right to survive, and nations' correlative duties to enforce it, has been articulated for centuries. From the earliest days, the notion of environmental sustainability in ancient Greece envisioned Goddess Earth, or Gaia, for whom "provincial governors used to be promoted, rewarded or

153. See Dinah Shelton, *Human Rights, Environmental Rights, and the Right to Environment*, 28 STAN. J. INT'L L. 103, 105 (1991) (describing how basic rights are a "precondition" to all others).

154. *Id.* at 110.

155. See *supra* note 146, at 309 (explaining a litany of contemporary rights falling short of the bare essentials).

156. At best, these "laws" are considered to be "soft," which means that they are merely "advisory" and "one day, might mature into customary international law." Wirth, *supra* note 150, at 601 (adopting the softness definition articulated in Pierre-Marie Dupuy, *Soft Law and the International Law of the Environment*, 12 MICH. J. INT'L L. 420, 420-21 (1991)).

157. See Jonathan I. Charney, *May the President Violate Customary International Law?: The Power of the Executive Branch of the United States Government to Violate Customary International Law*, 80 AM. J. INT'L L. 913, 914-15 (1986) ("If a nation . . . seeks to alter an established rule of customary international law, it must forge a new state practice This development takes time [because] states interested in a new rule . . . must take action that violates existing law and must encourage others to do the same.").

158. Joseph L. Sax, *The Search for Environmental Rights*, 6 J. LAND USE & ENVTL. L. 93, 94 (1990).

159. The trouble caused by relying on contemporary rights to the environment is "that humanity has survived for many centuries without the new rights, that the rights are not likely to be implemented in any way in the foreseeable future, and that these new rights merely cause confusion because, they are vague and exaggerated in scope." Sohn, *supra* note 145, at 62.

160. In the case of *The Paquete Habana*, 175 U.S. 677, 686 (1900), the United States Supreme Court addressed a claim relating to the validity of a longstanding practice by combing history for the "earliest accessible sources" revealing its "increasing recognition." Among other sources, the Court cited dated orders of King Henry IV of England from the fifteenth century to establish the binding nature of the custom. *Id.*

punished according to the condition of land under their jurisdiction.”¹⁶¹ In fact, “[s]igns of erosion or other environmental damage led to admonishment or even exile, whereas healthy-looking land, regardless of the well being of its people, would be accorded approval.”¹⁶² These enforcements grew out of survival needs rather than politics.¹⁶³ The Bible adopted a principle bearing the same result, stressing “life-support value” in a number of passages.¹⁶⁴ Likewise, in Judaic history, the concept of *bal tashhit*, a “biblical injunction,” held that “[m]an bears the responsibility for the destruction—complete or incomplete, direct or indirect—of all objects that may be of potential benefit or use to mankind.”¹⁶⁵ The codification of environmental preservation for the purpose of ensuring survival also became commonplace in the medieval era in the theories espoused by St. Thomas Aquinas¹⁶⁶ and others.¹⁶⁷ Part V.C argues that nations must collaborate to fulfill that duty.

161. Krishna Prasad Oli, *Legal Instruments for Sustainable Environmental Management in Nepal*, 2 ENV'T & HIST. 231, 231 (1996); see also *id.* at 232 (discussing the development of a Nepalese sustainable resource management system dating to 2000 B.C. For the Greeks, these punishments served a necessary societal role of maintaining stability by influencing the rational observations of citizens. For example, see ERNST CASSIRER, *THE MYTH OF THE STATE* 76 (1946), explaining Plato's conception that:

The self-preservation of the state cannot be secured by its material prosperity nor can it be guaranteed by the maintenance of certain constitutional laws . . . [because] [w]ritten constitutions or legal charters have no real binding force, if they are not the expression of a constitution that is written in the citizens' minds.

For Cassirer, the principle that endures in modern times is that identification with the environment is the basis of social structure: “[b]y a first act of identification man asserts his fundamental unity with his human or animal ancestors—by a second act he identifies his own life with the life of nature.” *Id.* at 39.

162. Oli, *supra* note 161, at 231.

163. See *id.* at 232 (characterizing the development of Nepalese codes of *Smritis* and *Manusmriti* as “a survival strategy for the people”).

164. Martin LaBar, *A Biblical Perspective on Nonhuman Organisms: Values, Moral Considerability, and Moral Agency*, in RELIGION AND ENVIRONMENTAL CRISIS 76, 79 (Eugene C. Hargrove ed., 1986) [hereinafter RELIGIOUS CRISIS]. Authors specifically cite the “variety of references to food and water,” *id.*, as proof of the concept of the “stability of nature.” *Id.* at 84. *But cf.* Susan Power Bratton, *Christian Ecotheology and the Old Testament*, in RELIGIOUS CRISIS, *supra*, 53, 53 (noting that “[h]istorians . . . have blamed either the church or biblical writings for encouraging abuse of nature”).

165. Johnathan Helfand, *The Earth is the Lord's: Judaism and Environmental Ethics*, in RELIGIOUS CRISIS, *supra* note 164, at 38, 44-45 (explaining the legal basis for “[t]he nineteenth-century Code of Shneur Zalman of Ladi”).

166. See JOHN FINNIS, *AQUINAS: MORAL, POLITICAL AND LEGAL THEORY* 191 (1998) (noting St. Thomas Aquinas's premium on the “resources one needs for the very survival of oneself and one's dependents,” and that “everything one has is ‘held as common . . .’ in the sense that it is morally available, as a matter of right and justice, to anyone who needs it to survive”) (emphasis in original). The axiom Aquinas established was that “in situations of extreme necessity, everything becomes common, i.e., ownership or other legal title is morally superseded for the duration of the situation.” *Id.* at 192-93 n.30.

C. NATIONS' DUTIES TO COOPERATE IN PRESERVING THEIR SUBJECTS' SURVIVAL

The earliest notions of human preservation were inextricably linked with theoretical conceptions of the individual as a political being. Thomas Hobbes's theory of the reasoned individual existing in the state of nature is perhaps the strongest support for an inalienable right to preservation.¹⁶⁸ According to Hobbes, the basis of the right is

the Liberty each man hath, to use his own power, as he will himselfe [sic], for the preservation of his own Nature; that is to say, of his own Life; and consequently of doing any thing, which in his own Judgment, and Reason, hee [sic] shall conceive to be the aptest means thereunto.¹⁶⁹

Thus, the justification for abiding by societal rules is the government's assurance that the governed will survive.¹⁷⁰ Accordingly, all "[b]asic moral

167. See Oli, *supra* note 161, at 232 (explaining the legal system of "punishment for environmentally unsound behaviour" adopted by Nepalese King Jayasthiti Malla of Kathmandu, circa 422 A.D.); Jane J. Mansbridge, *The Rise and Fall of Self-Interest in the Explanation of Political Life*, in BEYOND SELF-INTEREST 3-4 (Jane J. Mansbridge ed., 1990) (explaining the understanding of Manegold of Lautenbach, who in the eleventh century, described the King's duties of establishing a "common good" of societal preservation in enforcing citizens' rights to defend their property, and how it grew from the Sophists' assertion that "human beings came together in political association for the self-interested reason of mutual defense"); RONALD W. CARSTENS, THE MEDIEVAL ANTECEDENTS OF CONSTITUTIONALISM 55 (1992) (crediting John of Paris (1250/4-1304) for the ideal of "stewardship as an authorization to use or to distribute goods," which held that "the community determines jurisdiction over the use of common things"); *id.* at 81 (citing Marsilio of Padua (1275/80-1342), whose theory rested on the Aristotelian notion that "[t]he utility of government is measured by the degree to which it can provide the conditions necessary for a 'sufficient life'"); René Dubos, *Franciscan Conservation Versus Benedictine Stewardship*, in ECOLOGY AND RELIGION IN HISTORY 114, 123 (David Spring & Eileen Spring eds., 1974) (noting that "[a]mong the great Christian teachers, none is more identified with an ethic of nature than Francis of Assisi (1182?-1226), who treated all living things and inanimate objects as if they were his brothers and sisters[,] [as if] . . . arranged in a continuous series—the Great Chain of Being").

168. See THOMAS HOBBS, LEVIATHAN OR THE MATTER, FORME & COMMONWEALTH, ECCLESIASTICALL AND CIVIL ch. XV, at 105 (A.R. Waller ed., 1904) (1651) (identifying inalienable rights as those dealing with "all . . . things without which a man cannot live, or live well"). Hobbes also observed the sovereign's duty to protect those "things held in propriety, those that are dearest to a man are his own life & limbs; and in the next degree (in most men), those that concern conjugal affection; and after them riches and means of living." *Id.* at ch. XXX, at 248; GREGORY S. KAVKA, HOBBSIAN MORAL AND POLITICAL THEORY 322 (1986) ("Hobbes argues that the right to resist wounds and imprisonment, as well as the right to resist death, is inalienable."). *But see id.* (arguing that these rights are not inalienable because they may be given as gifts).

169. HOBBS, *supra* note 168, at ch. XIV, at 186.

170. See KAVKA, *supra* note 168, at 317 (applying Hobbes's theory to conclude that one may "reasonably refuse to abide by the results of a lifeboat lottery that [she] lose[s], on the grounds that [she has] no assurance that the other party or parties would have complied had he or they lost"). This allowance for self- rather than organizational-governance shows the importance of States' protection of the environmental security of their citizens.

rules are *natural*, in the sense of being derivable by reason from the universal common interest in social peace."¹⁷¹

Just as the individual's ability to survive creates a unique reasoned identity that allows for political action, theorist Friedrich Meinecke provided that State action derives from this same nucleus.¹⁷² In his view of *raison d'état*, or Reason of State, Meinecke opined: "The elementary biotic 'striving for security and self-preservation at any price' is behind all conduct . . . and to condemn and curse it is about as reasonable as to condemn and curse the leopard for its spots."¹⁷³ Meinecke believed that a State develops a personality from "a great extension of the individual personality and its sphere of life," in which "[t]he human being needs the community to sustain him, and to receive his contributions in turn."¹⁷⁴ Because of this symbiotic and dependent relationship, State "actions bear a general character in that they spring from a natural impulse [of self-preservation] which is permanent and common to all States."¹⁷⁵ In yet another passage, Meinecke notes that justified State actions are those that exist "only as a means towards a rationally predetermined object[:] for the sake of the security, [or] the well being" of its members.¹⁷⁶ In other words, the authority of a nation to govern depends on the State's ability to meet its citizens' most basic survival needs. From this principle, it follows that nations must work together to prevent threats that may potentially devastate any or all of them. The *Island of Palmas* decision so stated, when the arbitrator recognized the following:

Territorial sovereignty . . . involves the exclusive right to display the activities of a State. This right has as corollary a duty: the obligation to protect within the territory the rights of other States, in particular their right to integrity and inviolability in peace and in war, together with the rights which each State may claim for its nationals in foreign territory. Without manifesting its territorial

171. *Id.* at 452 (emphasis in original).

172. For a more modern conception that the right of a collective to survive is rooted in individual rights to survive, consider the case of *Franklin Township v. Commonwealth of Pennsylvania*, 452 A.2d 718, 720 (Pa. 1982), which held that a town was inextricably linked with the individuals who lived in it, thus giving the town standing to sue for the individual constitutional right to environment.

173. W. Stark, *Editor's Introduction*, in FRIEDRICH MEINECKE, *MACHIAVELLISM: THE DOCTRINE OF RAISON D'ETAT AND ITS PLACE IN MODERN HISTORY* xxxii (Douglas Scott trans., 1957) (1924) [hereinafter MEINECKE, *MACHIAVELLISM*].

174. FRIEDRICH MEINECKE, *COSMOPOLITANISM AND THE NATIONAL STATE* 14 (Felix Gilbert trans., 1970).

175. MEINECKE, *MACHIAVELLISM*, *supra* note 173, at 2.

176. *Id.* at 213; see Margaret Gruter, *The Origins of Legal Behavior*, 2 J. SOC. BIOLOGICAL STRUCTURES 43, 43 (1979) (observing a self-preserving philosophy in the development of domestic and international law and highlighting that "legal behavior" is often "an innate biological mechanism, vital for survival").

sovereignty in a manner corresponding to circumstances, the State cannot fulfil this duty. Territorial sovereignty cannot limit itself to its negative side, i.e. to excluding the activities of other States; for it serves to divide between nations the space upon which human activities are employed, in order to assure them at all points the minimum of protection of which international law is the guardian.¹⁷⁷

In the Earth collision context, or in the case of similar transboundary disasters where borders might change at any minute based on the migration patterns of citizens hoping to sustain themselves, all Earth becomes the protected “space upon which human activities are employed,” that is, protected by the mutual obligation to enforce the global right to survival.¹⁷⁸

The many environmental rights found in both national and state constitutions provide a strong argument that historical conceptions of the right to global survival continue to this day. Seven American states have language in their constitutions establishing rights to a healthy environment.¹⁷⁹ Of these states, Hawaii and Illinois have made these rights self-executing—meaning they are actionable by individuals without enabling legislation.¹⁸⁰ Pennsylvania and Montana have not directly created self-executing rights to a healthy environment, but in both the of these states, “courts have interpreted the [constitutional] provision[s] as allowing

177. *Island of Palmas Case (U.S. v. Neth.)*, 2 Rep. Int'l Arbitral Awards 829, 839 (1928) (Perm. Ct. Arb. 1928).

178. This theme is similar, yet distinct, from international decisions validating otherwise unlawful acts on the basis of necessity to self-preserve. See CHENG, *supra* note 134, at 71 (defining the requirements of a necessity plea involving peril sufficient to “supercede[] all laws,” “dissolve[] the distinctions of property and rights” and justify[] the “seizure and application to our own use of that which belongs to others” (quoting *The Neptune*, reprinted in IV INTERNATIONAL ADJUDICATIONS: MODERN SERIES 372, 433 (John Bassett Moore ed., 1931) (decided in 1797)). Appeals to necessity, however, require that the peril be “actual and not merely apprehended.” CHENG, *supra* note 134, at 71. The claim might arguably survive scrutiny in the realm of a serious Earth impact if the collision would be so immense as to render impossible spontaneous acts of self-preservation, instead requiring prior planning.

179. See, e.g., HAW. CONST. art. XI, § 9 (“Each person has the right to a clean and healthful environment.”); ILL. CONST. art. XI, § 1 (amended 2001) (“The public policy of the State and the duty of each person is to provide and maintain a healthful environment for the benefit of this and future generations.”); MASS. CONST. ANN. art. XLIX (amended 2001) (“The people shall have the right to clean air and water . . . and the natural . . . qualities of their environment; and the protection of the people in their right to conservation, development and utilization of . . . natural resources is . . . a public purpose.”); MONT. CONST. art. II, § 3 (“All persons . . . [have inalienable rights to] a clean and healthful environment and the rights of pursuing life’s basic necessities.”); R.I. CONST. art. I, § 17 (noting that the people “shall be secure in their rights to the use and enjoyment of the natural resources of the state . . . and it shall be the duty of the general assembly to provide for the conservation of air, land, water . . . and other natural resources of the state”).

180. Mary Ellen Cusack, Comment, *Judicial Interpretation of State Constitutional Rights to a Healthful Environment*, 20 B.C. ENVTL. AFF. L. REV. 173, 183-84 (1993).

individuals to assert [environmental rights] claims.”¹⁸¹ While some constitutional provisions guard against interference with citizens’ use and enjoyment of the environment, both Illinois and Rhode Island “specifically place a duty on the state government to preserve and maintain a healthful environment.”¹⁸² Absent these specific duties, courts in most states protecting such environmental rights overwhelmingly hold governments responsible for their enforcement.¹⁸³ A number of nations follow the same principle.¹⁸⁴

Because states and nations with different values have identified the same basic needs, international conceptions of these rights do not differ to the degree that would necessarily render the right unenforceable.¹⁸⁵

181. *Id.* at 185.

182. *Id.* at 192 (noting additionally that Montana’s provisions place “obligation[s] to respect each individual’s right to a healthful environment on all persons, individual and government actors alike”).

183. *See id.* at 195 (“In general, state courts hearing these claims have recognized that [environmental] constitutional provisions . . . do place obligations on a state government to preserve and maintain the environment.”).

184. *See* BRAZ. CONST. art. 225 (1998), *reprinted in* 1 CONSTITUTIONS OF THE COUNTRIES OF THE WORLD 26 (Gilbert H. Flanz ed., 2001) (“Everyone has the right to an ecologically balanced environment, which is a public good for the people’s use and is essential for a healthy life. The Government and the community have a duty to defend and preserve the environment for present and future generations.”). Most sources cite the Brazilian Constitution as a key example of the right and duty to protect the environment. *See also* Ernst Brandl & Hartwin Bungert, *Constitutional Entrenchment of Environmental Protection: A Comparative Analysis of Experiences Abroad*, 16 HARV. ENVTL. L. REV. 1, 82 tbl.1 (1992) (citing five nations’ constitutions that guarantee fundamental environmental protections); Wirth, *supra* note 150, at 617:

The constitutions of a number of States, including . . . Chile, Ecuador, Honduras, the Republic of Korea, Nicaragua, Norway, Peru, the Philippines, Portugal, South Africa, and Spain, explicitly pronounce an individual right to a clean and healthy environment. In addition, the constitutions of others, including China, Greece, India, Iran, Namibia, the Netherlands, Panama, Sri Lanka, Sweden, and Thailand, create a related but distinct duty on the part of the state to protect and preserve the environment for the benefit of individuals.

185. *See* ALEX INKELES, NATIONAL CHARACTER: A PSYCHO-SOCIAL PERSPECTIVE 139 (1997) (“Since all human beings manifest the same basic needs, we cannot assert that some need is unique to a given national population.”). Inkeles goes on to suggest the following:

Every social system depends for sustained existence on the presence in its status incumbents of certain psychic characteristics Because all social systems have certain requirements that are extremely general, it follows that in certain respects the psychic structure of all populations must share some psychological properties in common. These constitute the common psychic core of humankind The features of personality having this “system-typed” character will be those more required by or adaptive to, the main features of ecology. . . .

Id. at 208-09. Professor Inkeles shows that citizens of the world are linked by basic needs to survive and then nationally linked by more State-specific practices. Accordingly, those critics who claim, for example, that “as long as the law of human rights is in turmoil, [S]tates cannot be expected to agree on implementation measures,” Sohn, *supra* note 145, at 62, are addressing materializations of the national personality, rather than the global one. But, in all cases, a

Although several incompatible beliefs prevent all states and nations from providing citizens exactly the same environmental protections, a fine line separates citizens' most basic needs from needs that have evolved based on political or cultural considerations. The right to survive in the environment, as I have defined it, exists as the most common denominator among all governments, local or national, and is necessary for their very existence.¹⁸⁶

Historically entrenched practices continue to shape the world's disaster-based laws. Perhaps the most potent instance of an international duty of preservation guiding international legal decisions was Skylab's emergency descent to the Earth in 1979.¹⁸⁷ Although several nations realized this orbiting space station was about to fall, they did not know the extent of the danger it would pose,¹⁸⁸ much like the threat of a space body falling from the sky.¹⁸⁹ NASA and the State Department employed a legal strategy based on the notion of global preservation. Not only did these agencies recognize the duty to mitigate damage in other countries,¹⁹⁰ their plan called for deflecting space debris into the United States in order to avoid harming

person must be able to live before she can claim a national identity.

186. In recognition of all individuals' most basic needs, international courts have found States warranted in acting on behalf their own nationals when a host nation's treatment of these aliens constitutes "an outrage . . . [,] bad faith . . . willful neglect of duty, or . . . an insufficiency of governmental action so far short of international standards that every reasonable and impartial man would readily recognize its insufficiency." *Neer Case (U.S. v. Mex.)*, 4 Rep. Int'l Arbitral Awards 60, 61-62 (U.S.-Mex. Claims Comm'n 1926). Notwithstanding other duties to preserve human life, *Neer* signifies the notion that certain minimal living conditions can be so abhorrent as to require international intervention.

187. Skylab was an orbiting space station that NASA used to conduct a number of space missions. Because NASA administrators launched the station without planning for its reentry into the Earth's atmosphere, the station created a great deal of international panic when it drifted back toward the Earth and broke into a number of pieces. See generally *Skylab Hearings*, *supra* note 71, at 9-39 (1978 Battelle Report).

188. See Talma Kushnir, *Skylab Effects: Psychological Reactions to a Human-Made Environmental Hazard*, 14 ENV'T & BEHAV. 84, 84-85 (1982) ("While the fall was inevitable, its exact timing, location, and consequences were unpredictable.").

189. The precedential value of this event may be more valuable than "anecdotal" evidence about minimal asteroid harms humans have experienced in the past. See *id.* at 89 (noting public disinterest in falling meteors, but recognizing that "the fall of Skylab was the first (and much publicized) [international] event of its kind"). The threat was so similar to an asteroid impact that NASA, in creating an emergency plan to deal with the Skylab threat, analogized this man-made disaster to an asteroid impact. See generally *Skylab Hearings*, *supra* note 71, at 9-39 (1978 Battelle Report) (comparing Skylab debris with space bodies).

190. See *Skylab Hearings*, *supra* note 71, at 73 (statement of Dr. Robert A. Frosch, NASA Administrator):

In the event of an impact in a foreign country, if the foreign country chooses to accept U.S. assistance, NASA would be notified by the Department of State and would deploy its [debris identification] teams as required [to compensate victims for damage]. NASA personnel would be under the jurisdiction of the ambassador while in that country. Assistance would be provided by the DOD [medical and engineering teams], as appropriate.

more densely populated regions.¹⁹¹ The Skylab emergency plan provides a legal framework for establishing an international obligation to mitigate asteroid or comet impacts. But the risk posed by an asteroid or comet impact necessitates the identification of more detailed and concrete obligations.¹⁹² Viewed alone, the station's descent leaves many questions unanswered regarding the limits of international cooperation.¹⁹³

VI. MODERN MANIFESTATIONS OF THE GLOBAL DUTY TO COOPERATE IN SELF-PRESERVATION EFFORTS

Although the previous section highlighted evidence of the "express duty

191. The following dramatic dialogue between Congressman John L. Burton and NASA's Administrator, Dr. Robert A. Frosch, should aid the present inquiry substantially:

Mr. BURTON: . . . My question to you is, I guess, a pretty tough question. If it looks like [Skylab] might fall on India, which has a heavy population, we could adjust its orbit, and then it might fall on America.

Dr. FROSCH. That is correct. We have proceeded and are proceeding on the view that the problem is to decrease further the small probability of injury to a human being anywhere.

Mr. BURTON. That is very noble. I think it is the first time—we spend billions of dollars making sure nobody injures us, and I think it is very noble that one of our own agencies would be willing to take a chance on the slight injury happening to the American people who are paying for the program as against Indians because India has a very dense population.

Skylab Hearings, *supra* note 71, at 80.

This duty to bear a national threat to save human life was not articulated in the treaties to which the United States was obligated by law, such as the Outer Space Treaty or the Liability Convention. Rather, the duty derived from the historically entrenched right of global preservation, which projected from the individual level to all of the international society. Although, in part, the United States was surely motivated by its responsibility for launching Skylab, the principle articulated by Dr. Frosch still represents a commitment to general principles of cooperative preservation. After all, nations collaborated in a similar way, developing a global contingency plan for the eventual descent of the Mir, even though they had not created the threat. For example, it was said that the United States "Federal Emergency Management Agency [was] on standby," Michael Cabbage, *Down it Goes, Where Mir Will Land, Nobody Knows; The Station Should Crash at Sea, but Russia is Hedging its Bets*, ORLANDO SENTINEL, Mar. 18, 2001, at A1, available at LEXIS, Nexis Library, News Group File, and "[t]he Defense Dept. pulled together a network of all U.S. government agencies to monitor the descent with Space Command in Colorado Springs the lead agency." Frank Sietzen, Jr., *Mir: Resting in Peace*, AEROSPACE AMERICA, May 2001, at 36, available at LEXIS, Nexis Library, News Group File. In fact, "[m]ore than 80 countries . . . expressed an interest in the reentry," including Japan, which activated all of its emergency personnel, and Australia, which developed detailed international contingencies. *Id.* (quoting David Templeman, Australia's Emergency Management Director General).

192. Major differences between the Skylab threat and the general threat of asteroid or comet impact are the amount of warning prior to the potential disaster and that the size of the impacting object and the corresponding damage posed in Skylab's case was significantly less threatening than an asteroid or comet impact.

193. See Brooks, *supra* note 37, at 248 (explaining the unresolved legal questions pertaining to potential space body collisions).

to self-preserve and the related obligation to attain this objective collaboratively, a review of international agreements guiding nations in times of crisis should guide the efforts of lawmakers in achieving cooperative preservation, especially in recognizing the obligation to act beyond merely warning of impending danger. Such duties also show how historical conceptions of that right have evolved in step with modern technological advances.

On the basis of various treaties alone, several commentators have suggested that binding international obligations arise.¹⁹⁴ Certain doctrines address the questions posed by nuclear threats, while others address problems arising from falling space debris from man-made objects, and still others the problems associated with transboundary pollutants.¹⁹⁵ As long as these obligations are directed at preventing harm, it follows logically that threats from space bodies come within their ambit, owing to the potential severity of damage and the threat to life. The following sections explore existing duties to warn and to take responsive action.

A. DUTIES TO WARN OF IMPENDING DANGER

Governments that become aware of significant impending danger often must contact those entities they know to be directly at risk, even when the threat is likely to occur outside their own territorial limits. In the United States, for example, constitutional scholars have argued that the Preamble of the Constitution implies a duty to warn citizens of impending dangers.¹⁹⁶ More recent affirmations of this duty occur in statutes that require communities to notify citizens about toxic and industrial hazards.¹⁹⁷ This duty derives from either a "right to know" about environmental health risks, as the obligation is recognized in the United States, or from a "need to know," as it is recognized by other nations.¹⁹⁸ In either case, governments must alert citizens of certain facts that might increase their safety in times of

194. See WEISS, *supra* note 114, at 70-79 (explaining the existence of shared international duties emerging from treaties before 1988).

195. See *infra* notes 203, 207 and accompanying text (explaining respective provisions of varied agreements between States).

196. See Brooks, *supra* note 37, at 243 (citing the Preamble to the U.S. Constitution to show an "obligation to notify . . . citizens of any possible threat to life").

197. See, e.g., The Emergency Planning and Community Right to Know Act, 42 U.S.C. §§ 11001-11050 (1994) (requiring states to coordinate for the identification and dissemination of chemical risks to the public); 42 U.S.C. §§ 11001(c), 11003 (1994) (mandating comprehensive emergency and evacuation plans for chemical facilities posing public risks); Council Directive 82/501/EEC on Major Accident Hazards of Certain Industrial Activities, 1982 O.J. (L 230) (as amended by 87/216/EEC, 19 Mar. 1987, and 88/8610/EEC, 24 Nov. 1988 (also known as the Seveso Directive)) (requiring European states to collect and disseminate information about public industrial risks through a Central Commission).

198. See Gary Rischitelli, *Developing a Global Right to Know*, 2 ILSA J. INT'L & COMP. L. 99, 110 (1995) (noting how both duties emerge from environmental health risks).

danger. The significance of these duties is abundantly clear in current tort law, which holds governments financially responsible for inadequate public notification of known natural hazards.¹⁹⁹

Nations have recognized obligations to warn each other of impending peril similar to those obligations adopted for the safety of their own citizens.²⁰⁰ Such international treaties demonstrate “beyond reasonable dispute that the duty to notify potentially affected states of a transnational disaster has reached the level of customary international law.”²⁰¹ This duty emerges from multiple sources, including judicial decisions²⁰² and general agreements.²⁰³

Some of the duties to warn relate directly to space disasters. For example, the Outer Space Treaty contains key provisions that collectively suggest a duty to warn nations of any space-related threat. Article V addresses notification directly,²⁰⁴ while Articles I and IV mandate sensitivity

199. For example, see *Brown v. MacPherson's, Inc.*, 545 P.2d 13, 17-18 (Wash. 1975) (en banc), which held that a state was financially responsible for public injuries resulting from its failure to issue adequate warnings, which includes the complete failure to notify the public of dangers.

200. See *infra* notes 204-09 and accompanying text (explaining provisions of various agreements).

201. McClatchey, *supra* note 109, at 669.

202. See *Trail Smelter Case* (U.S. v. Can.), 3 Rep. Int'l Arb. Awards 1905, 1965 (1938) (holding that “no state has the right to use or permit the use of its territory in such a manner as to cause injury . . . in or to the territory of another”); *Corfu Channel Case* (U.K. v. Alb.), 1949 I.C.J. 4, 22 (Apr. 9) (confirming the State duty “not to allow knowingly its territory to be used contrary to the rights of other states” and holding that Albania had a duty to warn British ships about its mined harbors); cf. PATRICIA BIRNIE & ALAN BOYLE, *INTERNATIONAL LAW AND THE ENVIRONMENT* 141-44 (1992) (explaining alternative conceptions of the *Corfu Channel* holding, limiting the duty to dangers in a State's own territory).

203. See *Convention on Early Notification of A Nuclear Accident*, Sept. 26, 1986, 1439 U.N.T.S. 275 (entered into force Oct. 27, 1986, signed but not ratified by the U.S.), 25 I.L.M. 1370, art. (1) (mandating notification of “an international transboundary release that could be of radiological safety significance for another State”); *Protocol on Environmental Protection to the Antarctic Treaty*, Oct. 4, 1991, arts. 6, 8, 30 I.L.M. 1455, 1464 (mandating the sharing of information about potential environmental risks in Article 6 and requiring notification of major impacts to both the public and parties involved in scientific activities in Article 8); *RIO DECLARATION*, *supra* note 18 (proclaiming, in Principle 18, that States must “immediately notify other States of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those States” and, in Principle 19, that “States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary effect and shall consult with those States at an early stage and in good faith”).

204. See *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, Jan. 27, 1967, art. V, 18 U.S.T. 2410, 610 U.N.T.S. 205 (entered into force Oct. 10, 1967) [hereinafter *Outer Space Treaty* or *OST*] (“States Parties to the Treaty shall immediately inform other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space . . . which could constitute a danger to the life or health of astronauts.”). Alone, this provision seems to avoid threats extending beyond astronauts in space. See Brooks, *supra* note

towards all nations' interests²⁰⁵ and international cooperation in all space operations.²⁰⁶ While the OST may only touch on the exploration of space, other resolutions concerning space obligate nations to act on similar, if not heightened, duties of notification. Two such duties address nuclear power²⁰⁷ and remote sensing technologies.²⁰⁸ In particular, these regulations require any nation with the capability of monitoring an object in space to do so for the benefit of potential victims in other nations.²⁰⁹ Because nations are required to act on these doctrines regardless of the resources they are able to commit, nations should be required to treat threats posed by space bodies in a similar manner. But duties to warn of asteroid impacts are less crucial than the related obligation to respond to the devastation that may follow on the heels of such warnings.

B. DUTIES TO ACT BEYOND WARNING

Unlike duties to warn nations of danger, duties to act beyond simply giving warning imply that nations must mobilize their own resources to aid others. These concerns prompt some scholars to argue that a nation must take care of its own citizens before aiding the people of other countries (e.g., that any aid provided to the people of other countries will mean

37, at 245 (arguing that Article V “falls short of [asteroid impact] notification of dangers to the population of the world at large”). Yet, in the context of Articles I and IV, the provision’s mandate may extend further. *See infra* notes 215-17 and accompanying text.

205. *See* Outer Space Treaty, *supra* note 204, at art. I (conveying that “[t]he exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries . . .”).

206. *See id.* at art. IV (requiring that all States’ actions are “guided by the principle of cooperation and mutual assistance” and conducted with “due regard to the corresponding interests of all other States party to the Treaty”).

207. *See Principles Relevant to the Use of Nuclear Power Sources in Outer Space*, G.A. Res. 47/68, U.N. GAOR, 47th Sess., Supp. No. 20, U.N. Doc. A/47/20 prin. 7(1) (1992) [hereinafter *Nuclear Power Principles*]:

Upon the notification of an expected re-entry into the Earth’s atmosphere of a space object containing a nuclear power source . . . all States possessing space monitoring and tracking facilities, in the spirit of international cooperation, shall communicate the relevant information that they may have . . . to the Secretary-General of the United Nations and the State concerned as promptly as possible to allow States that might be affected to access the situation and take precautionary measures.

208. *See Principles Relating to Remote Sensing of the Earth from Outer Space*, G.A. Res. 41/65, U.N. GAOR, 41st Sess., prin. 11 (1986):

Remote sensing shall promote the protection of mankind from natural disasters. To this end, States participating in remote sensing activities that have identified processed data and analyzed information in their possession that may be useful to States affected by natural disasters, or likely to be affected by impending natural disasters, shall transmit such data and information to States concerned as promptly as possible.

209. *See supra* notes 207-08.

leaving its own citizens' needs unmet).²¹⁰ Despite these arguments, numerous international agreements create a duty to actively prevent harm²¹¹ and develop future plans for decreasing known or inevitable risks of harm.²¹² For example, Article 28 of the International Law Commission's Draft Articles on the Law of Non-Navigational Uses of International Watercourses requires all Watercourse States to "immediately take all practicable measures necessitated by the circumstances to prevent, mitigate and eliminate harmful effects" of natural disasters occurring in their territory.²¹³ Article 27 also requires joint disaster mitigation activities, regardless of the disaster's origin.²¹⁴ Such duties collectively suggest an international obligation to assist threatened nations upon learning of impending danger.

Outer Space law also provides for duties to mobilize resources in the case of danger. Aside from its warning provision, The Outer Space Treaty (OST) proclaims that nations capable of so doing must render aid to astronauts in danger.²¹⁵ While the OST limits the scope of danger to harm encountered in space, Article V stresses the fact that astronauts in distress require access to common resources while the danger exists.²¹⁶ For the same reason, the Treaty also compels nations to aid astronauts who land in their territory.²¹⁷ This duty to limit harm, considered with other duties discussed

210. See HENRY SHUE, *BASIC RIGHTS: SUBSISTENCE, AFFLUENCE, AND U.S. FOREIGN POLICY* 9 (1996) (noting that critics of extending obligations can always complain that "recognizing the right in question would place too great a burden on all the other people with the duties to honor the right").

211. See Wirth, *supra* note 150, at 639 n.106 (identifying numerous treaties requiring state intervention to limit damage).

212. See *id.* at 638 n.108 (identifying treaties requiring states to adopt preventive disaster emergency response plans).

213. International Law Commission, *Draft Articles on the Law of the Non-Navigational Uses of International Watercourses*, art. 28 (3), U.N. GAOR, 49th Sess., Supp. No. 10, at 197, U.N. Doc. A/49/10 (1994), available at <http://www.un.org/law/ilc/texts/94nonnav.pdf#pagemode=bookmarks>.

214. *Id.* at art. 27 (requiring States to "individually or jointly, take all appropriate measures to prevent or mitigate conditions that may be harmful to other . . . States, whether resulting from natural causes or human conduct").

215. See Outer Space Treaty, *supra* note 204, at art. V ("In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.").

216. Note the similarity of this provision to historical theories about duties of preservation, most notably those of Aquinas discussed *supra* note 166.

217. See Outer Space Treaty, *supra* note 204, at art. V ("States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas."). This doctrine is similar to the treaty covering emergency landings of aircraft. See Chicago Convention on International Civil Aviation, Dec. 7, 1944, art. 25, 59 Stat. 1516, 15 U.N.T.S. 295, 312 (outlining State duties to "provide such measures of assistance to aircraft in distress in its territory as it may find practicable" as well as the duty to allow aid from the country of origin in both searching for missing planes and providing assistance to downed pilots and passengers).

earlier, suggests that space-related disasters command a different set of international obligations on the part of sovereign nations. Principle VII of the Nuclear Power Principles highlights this unique responsibility by requiring nations to limit harm even if they have nothing to do with its creation.²¹⁸ This Principle recognizes the fact that nuclear threats potentially endanger the entire globe and transcend sovereign rights to refuse to provide aid. An Earth collision differs from nuclear disaster only in its heightened severity, a realization that should compel at least the same international obligation.

VII. RECOMMENDATION AND CONCLUSIÓN

Although both historic obligations and existing practices reveal an international commitment to both self-preservation and shared international disaster relief obligations, questions remain regarding the willingness of nations to adhere to cooperative preservation efforts respecting space bodies. After all, nations often neglect even those treaties to which they have joined as parties.²¹⁹ But, in the context of preventive measures to mitigate unforeseeable threats, cooperative preservation does not envision punishment for noncompliance. Instead, the legal concepts I have presented above should provide compelling reasons to evaluate environmental security risks in a new light—one where nations that are willing to address the issue can do so in an orderly way—with processes spelling out the delineation of responsibilities.

Certain dangers are so devastating that, upon their occurrence, governments inevitably develop plans to prevent similar harm. Chernobyl, Hiroshima and Nagasaki, and the World Trade Center attacks all marked events so horrific that nations rallied the resources to make a sustained collective effort necessary to regulate matters.²²⁰ If an asteroid or comet of

218. See *Nuclear Power Principles*, *supra* note 207, at prin. 7(2)(b) (holding that “[a]ll states, other than the launching state, with relevant technical capabilities and international organizations with such technical capabilities shall, to the extent possible, provide necessary assistance upon request by an affected State”). Note, however, that the principles are non-binding.

219. See *Watson*, *supra* note 38, at 782 (doubting the power of treaties to secure international legal compliance).

220. In an effort to respond to the horrors of Chernobyl, governments collectively developed new principles delineating duties to prevent such harm. See *McClatchey*, *supra* note 109, at 666-69 (attributing provisions of the Rio Declaration and the International Law Commission’s Draft Articles on the Law of Non-Navigational Uses of International Watercourses specifically to Chernobyl). Likewise, to prevent nuclear fallout, the nature of that experienced following the bombing of Japan in the 1940s, the international community coordinated to regulate the testing of such weaponry. See *United Nations Comprehensive Test Ban Treaty*, Sept. 24, 1999, U.N. Doc. A/50/1027, Annex, *reprinted in* 35 I.L.M. 1439 (1996) (articulating guidelines). Not surprisingly, nations promptly joined forces in the new war on terrorism following attacks on the World Trade Center and the Pentagon. See *Paul de la Garza & Dong-Phuong Nguyen*, *MacDill’s New ‘Village’ Helps Coordinate Globe*, ST. PETERSBURG TIMES, Oct. 27,

significant mass should strike a populated area, citizens of the world would undoubtedly expect to see implemented many of the preventive efforts I have urged.²²¹ After all, nations must prevent their citizens from returning to the Hobbesian state of nature described in Part V.C.²²² When nations do not adequately handle serious threats, their citizens will often lose faith in figures of power.²²³ As a result, governments tend to respond immediately, and perhaps in an even more exaggerated way than necessary, to assure

2001, at 1A, available at LEXIS, Nexis Library, News Group File (describing the development of one of many "coalition village[s]," which are coordination centers that combine the expertise of several nations' task forces in fighting terrorism).

221. Cf. FRAZIER, *supra* note 13, at 339 (explaining how "ironically, it often takes a disaster to get people [and governments] to prepare for (the next) disaster").

222. For at least three days after a serious disaster, life for the average citizen often resembles a state of anarchy, where governments are unable to function in their authoritative role. See Lisa A. Russell et al., *Preparedness and Hazard Mitigation Actions Before and After Two Earthquakes*, 27 ENV'T & BEHAV. 744, 745 (1995) (describing how "the normal flow of goods and services will be disrupted [and] emergency personnel will be overwhelmed and unable to respond to every need" following a disaster like a major earthquake).

223. For the most part, most citizens are inexperienced with threats of a high magnitude. They perceive horrific results. See Kushnir, *supra* note 188, at 89-91 (describing "unrealistically high" perceptions of risks based on mental cues that influence victims to imagine the worst experiences conceivable and a general "fear of science and technology"). Citizens also overestimate the government's ability to respond to them. See Russell et al., *supra* note 222, at 768-69 (describing how the public "overestimate[s]" a government's ability to respond to its needs during times of emergency). Often, they are likely to perceive deception on the part of the government because their expectations of the government exceeded its abilities. For example, Suzanne Keller, in *Ecology and Community*, in LAW, VALUES, AND THE ENVIRONMENT: A READER AND SELECTIVE BIBLIOGRAPHY 10, 13 (Robert N. Wells, Jr., ed., 1996), noted:

Perhaps the most serious consequence of major environmental accidents . . . is the ensuing decline in respect for authority in science and politics. Survivors of these accidents discredit the scientific elite for both its technical failures and its self-righteous arrogance. They resent the political authorities for their incompetence, deception, and disparagement of the public. Typically, there is outrage at the long delays by officials in responding to the emergency. Moreover, what the officials finally offer is generally too little and too late . . . When the authorities fail to respond, it increases the collusion that citizens perceive exists between scientists and governments.

While this commentator referred to common perceptions of man-made environmental disasters like Chernobyl or Bhopal, these public perceptions were based on the same lack of anticipation that likely characterizes asteroid and comet collisions. In other words, "[b]ecause we do not anticipate such accidents, we cannot effectively prepare for them or respond to them." *Id.* at 11. Yet another similarity between those accidents and asteroid or comet threats is "technological overconfidence." *Id.*; see also *supra* note 77 and accompanying text (describing similar preoccupations with NEO cataloguing efforts). Perhaps public distrust in government will be more likely following an asteroid or comet impact, given scientists' common "official response . . . [of] discount[ing] the magnitude of the accident [with the hope of] minimiz[ing] the human suffering that it engendered." Keller, *supra*, at 10. Prior planning with other countries will reinforce the hopes of citizens in devastated communities that help will be on the way, giving them a reason to comply with interim State mandates. At the very least, increased public trust may slow the panicked migration of people perceiving a state of total anarchy in their own devastated regions.

their citizens that their safety will be preserved. This Note holds nations to a higher standard of responsibility. Nations should no longer be preoccupied with the present, but should plan for the future. Governments must address serious concerns about allocating scarce resources and lay plans to cope with the horrific realities that will inevitably accompany megadisasters.

Identifying legal bases to cooperate is more important than simply outlining the innerworkings of international organizations that one hopes will fulfil such obligations. Organizational models abound. For example, shortly after the devastation of the atomic bombings in Japan, Bernard Baruch urged the development of a single international entity to regulate all atomic issues.²²⁴ At the heart of the Baruch Proposal was the realization that certain threats may be so devastating as to require a united effort of all humankind.²²⁵ Cooperative preservation envisions a similar organizational response to threats to environmental security. Perhaps the United Nations might develop a Convention on Asteroid Mitigation and Transnational Natural Disasters, with the goal of establishing an independent organization to develop protocols for dealing with megadisasters.²²⁶ Establishing an

224. See Honorable Bernard M. Baruch, United States Proposals for the Control of Atomic Energy, Presented by the Honorable Bernard M. Baruch to the United Nations Atomic Energy Commission, (June 14, 1946), in *THE UNITED STATES AND THE UNITED NATIONS*, REP. SERIES NO. 7, at 169 (1947) [hereinafter Baruch Proposal].

225. *Id.* at 169-72:

In this crisis, we represent not only our governments but, in a larger way, we represent the peoples of the world. We must remember that the peoples do not belong to the governments but that the governments belong to the peoples . . . The United States proposes the creation of an International Atomic Development Authority, to which should be entrusted all phases of the development and use of atomic energy.

The Baruch Proposal covered international "Managerial control," "Power to control, inspect and license," "The duty of fostering the beneficial uses of atomic energy," and "Research and development responsibilities," because "peoples . . . would not believe—and without faith nothing counts—that a treaty, merely outlawing possession or use of the atomic bomb, constitutes effective fulfillment of [the world's needs]." *Id.* at 172.

226. The organization could look somewhat similar to the Scientific Committee on Antarctic Research (SCAR), the international organization that has functioned for the last four decades in Antarctica. See *The Future of Antarctic Research: Hearing Before the Subcomm. on Basic Research of the Comm. on Sci.*, 104th Cong. 106 (1996) (describing how the Antarctic Treaty of 1959 "permits its Parties to undertake cooperative activities and agree on collective regulation of those activities" by using "consensus as the basic principle of decision-making" and using "substantial scientific research . . . as the basis for full participation in decision-making"). While SCAR "has no formal ties to the Antarctic Treaty, [it] serves as a source of expert scientific opinion" to guide the decisions necessary for the enactment of treaty provisions by "provid[ing] a continuing mechanism for the Antarctic scientific community to identify research priorities in Antarctica and promote cooperate efforts for their achievement." *Id.* at 168. Unlike the Deep Seabed Authority, SCAR has enjoyed years of successful operation. The Seabed Authority has experienced paralyzing tension for the last few decades. See generally de La Fayette, *supra* note 35 (describing seabed tensions). Additionally, when nations face threats from space, these dangers will be similar to threats occurring in the harsh and desolate Arctic tundra, i.e., nations will be

international body to deal with specific threats and develop binding solutions is not foreign to the United Nations.²²⁷ The most appropriate vehicle for mitigating Earth impacts by space bodies would mirror Professor Christopher Stone's recommendations.²²⁸ For the past several years, Stone has fostered the establishment of a "system of guardians who would be legal representatives for the natural environment."²²⁹ These guardians, would be endowed with special rights:

[T]he guardian would be built into the institutional process [I]ts first chore would be to *monitor*. It would review [environmental] conditions not just to gather facts "scientifically" Second, the Guardian would exercise *legislative function*, not as a legislative body, but as part of a complex web of global policy-making institutions It could appear before international agencies [concerning its discoveries and recommendations] Third, it could be authorized to appear as a special *intervenor-counsel* International treaties should endow the Guardian with standing to initiate legal and diplomatic action. . . .²³⁰

Because several organizations are currently empowered to deal with environmental harm less devastating than the harm posed by asteroids,²³¹ nations should develop a similar organization to address all transboundary megadisasters.

In the final analysis, regardless of our efforts to combat unknown environmental threats, "[j]ust as avoiding an all-out nuclear exchange becomes a first priority of superpowers, so avoiding general environmental

able to use only those mitigation strategies that they developed prior to the threatening event through collaborative efforts. For example, see Beebe, *supra* note 91, at 1769 n.241, who suggests that outer space, similar to Antarctica, is "like the top of Mount Everest, a place to which a man goes briefly to conquer or to die, and to which he does not take his wife and children." In other words, when facing a threat from space, countries will likewise be helpless without the aid of prior planning and collaboration.

227. The Ozone Convention, for example, requires international research and cooperation to achieve the control of human activities through a system of observation and correction. See Vienna Convention for the Protection of the Ozone Layer, Mar. 1985, arts. 3-4, 26 I.L.M. 1529 (1987) (entered into force Sept. 22, 1988) (outlining international responsibilities to collaborate).

228. See STONE, *How to Heal the Planet*, in ENVIRONMENTAL ESSAYS, *supra* note 112, at 81-99 (exploring organizational responses to nations' duties to protect the environment).

229. *Id.* at 87 (comparing environmental guardians to "conservators" in familiar legal systems).

230. *Id.* at 87-88 (emphasis in original).

231. For example, The National Oceanic and Atmospheric Administration is currently "trustee for fish, marine mammals, and their supporting ecosystems within the U.S. fisheries zone," and has standing to influence international decisions based on its guardianship powers. *Id.* at 88-89.

collapse becomes a first priority of all responsible states.²³² Collisions with Earth pose serious questions that perhaps only a diverse group of committed policymakers are capable of addressing successfully.²³³ By realizing the general principle of cooperative preservation and the need for proactive and anticipatory action to mitigate transnational disasters, we can begin to answer the legal questions relating to asteroid or comet impacts. Perhaps, these very principles will inform our understanding of the legal obligations related to other low probability, high consequence transnational crises.

Congressman Burton's fears about the U.S. government's role during the time of the Skylab crisis illustrate the concerns expressed in this Note: "I think I know what NASA is doing. They know they cannot control this, and they are scared to death. They don't know what to do. They will just do nothing and keep their fingers crossed, and maybe it will end up in the Indian Ocean."²³⁴ In other words, when Earth faces its next space-body collision crisis, let us hope and pray that there exists a functioning organization in which we can place our faith, rather than merely wishing on a star, for the survival of our species.

232. OCEANS, *supra* note 24, at 8.

233. Consider the array of unanswered asteroid impact questions posed by Dr. Eugene Brooks, *supra* note 37, at 248.

234. *Skylab Hearings*, *supra* note 71, at 177.