

**REVERBERATING EFFECTS IN ARMED CONFLICT: AN
ENVIRONMENTAL ANALYSIS**

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ABSTRACT

Since the 1991 Gulf War there has been considerable discussion regarding the proper scope of collateral damage in the proportionality principle. Most of this discussion has concerned cyber-attacks and the use of explosive weapons in urban areas. Consequently, other areas, like the environment, have largely been left from the discussion. This paper evaluates whether conflict parties are legally obliged to consider environmental reverberations in their proportionality assessment. First, it finds that the proportionality principle still plays a crucial role in protecting the natural environment from collateral damage. Second, it explores arguments for the inclusion of reverberating effects generally and then for environmental reverberations in particular. Third, it critiques these theories and suggests against including environmental reverberations. It finds that the law is unclear how the foreseeability and causation requirements should be applied. This is particularly difficult for environmental reverberations as they are often scientifically uncertain. Including reverberating effects also attributes sole responsibility to the attacking party, even where the victim has control over impacting factors. Reverberating effects further require considerable information and expertise resources, which militaries may not be able to provide.

International Humanitarian Law – Proportionality – Environment – Reverberating effects

I. INTRODUCTION

In the 1991 Gulf War, the United States military attacked the Iraqi electrical grid causing widespread harm to Iraqi civilians. While the grid provided for many military activities, it simultaneously provided power to many civilians and civilian services. Hospitals and community health centers lost power. Water and wastewater facilities were unable to work, leading to discharge of raw sewage into major rivers. As a result, drinking water became polluted and Iraq suffered an epidemic of diseases, including typhoid and cholera.¹ Post-war studies suggest that as many as 70,000 civilian deaths were attributable to the loss of electric power.² Scholars contend the ratio of military to immediate civilian deaths was “much higher” than other wars during that time.³ By contrast, the United States categorized its conduct as “the most discriminate air campaign in history”⁴ with “apparently low” civilian losses.⁵

International humanitarian law (IHL) restricts the level of damage permissible in armed conflicts.⁶ Described as an “intransgressible” norm and a “cardinal principle” of international humanitarian law,⁷ the principle of proportionality seeks to balance conflicting military and humanitarian interests during warfare. The substance of the principle is encapsulated in article 51(5)(b) of the Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) of 8 June 1977 (AP I).⁸ The principle prohibits attacks where the incidental loss of civilian life, injury to civilians, and damage to civilian objects (hereafter “collateral damage”) is excessive in relation to the concrete and direct military advantage anticipated. The principle does not prohibit collateral damage *per se*, but rather seeks to limit damage to what the military deems necessary. Where

¹ See Ian Lee & Andy Haines *Health Costs of the Gulf War*, 303 BRIT. MED. J. 303, 304 (1991) (for a full account of the health impacts of the United States’ attack on the Iraqi electric grid).

² J.W. Crawford, III, *The Law of Noncombatant Immunity and the Targeting of National Electric Power Systems*, 21 FLETCHER F. WORLD AFF. 101, 110 (1997).

³ Lee & Haines, *supra* note 1, at 306.

⁴ Principal Deputy Under Secretary, Conduct of The Persian Gulf War: Final Report to Congress (Public Law 102-25, April 1992) at 698 [hereinafter *Final Report to Congress*].

⁵ *Id.* at 240.

⁶ Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) art. 35, *opened for signature* June 8, 1977, 1125 U.N.T.S. 3 (*entered into force* Dec. 7, 1978). [hereinafter *AP I*].

⁷ Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. Rep. 226, ¶ 79 (July 8) [hereinafter *Legality of Nuclear Weapons Case*].

⁸ AP I, *supra* note 6, at 51(5)(b) states “Among others, the following types of attacks are to be considered as indiscriminate: ... (b) an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.” Indiscriminate attacks are prohibited under article 51(4).

disproportionate, conflict parties are obliged to lessen the collateral damage. For instance, conflict parties can change the weapon or method of attack, or if neither are unachievable, cancel the attack.

Despite the principle of proportionality being a fundamental principle of IHL, its application is debated.⁹ In particular, there is significant controversy regarding the proper scope of permissible collateral damage.¹⁰ There are two types of imaginable collateral damage: direct and indirect. Direct effects are “the immediate, first order consequences, unaltered by intervening events or mechanisms”.¹¹ By contrast, indirect effects are “those effects not directly and immediately caused by the attack that are nevertheless the product thereof.”¹² Indirect effects are referred to by numerous names including knock-on¹³ and reverberating effects,¹⁴ (hereafter referred to as reverberating effects). Reverberating effects are distinct from direct effects as they are affected by intermediate or intervening events and mechanisms.¹⁵ For these reasons, they usually do not materialize immediately after an attack. Rather, they tend to be delayed or displaced from the attack. Whether reverberating effects are included in proportionality calculations is a current source of debate.

This paper considers whether environmental reverberations should be included in proportionality calculations. This topic is crucial for two reasons. First, while the issue of reverberating effects is not new *per se*,¹⁶ it has experienced greater salience with the rise of urban and cyber warfare, with most literature focusing around these key areas.¹⁷ Other areas, such as environmental reverberations, are

⁹ See, e.g., Comments of Office of the Prosecutor, International Criminal Tribunal Final Report to the Prosecutor by the Committee Established to Review the NATO Bombing Campaign Against the Federal Republic of Yugoslavia (ICTY, 13 June 2000) at ¶¶ 48–50 [hereinafter *NATO Bombing Report*].

¹⁰ *Id.* at ¶ 38; see also, ICRC *Q&A on the Issue of Explosive Weapons in Populated Areas*, 98 INT’L. REV. RED CROSS 97, at 103–04 (2016).

¹¹ TALLINN MANUAL ON INTERNATIONAL LAW APPLICABLE TO CYBER WARFARE (Michael N. Schmitt ed., 2013) at 133 [hereinafter TALLINN MANUAL].

¹² Michael N. Schmitt, *Wired Warfare: Computer Network Attack and Jus in Bello*, 84 INT’L. REV. RED CROSS 365, 392 (2002).

¹³ See, e.g., *id.* at 392.

¹⁴ See generally, Isabel Robinson & Ellen Nohle, *Proportionality and Precautions in Attack: The Reverberating Effects of Using Explosive Weapons in Populated Areas*, 98 INT’L. REV. RED CROSS 107, 108 (2016).

¹⁵ TALLINN MANUAL, *supra* note 11, at 133.

¹⁶ See Frits Kalshoven, *Implementing Limitations on the Use of Force: The Doctrine of Proportionality and Necessity*, 86 AM. SOC’Y INT’L L. PRO. 39, 45 (1992); see also Ian Henderson & Kate Reece, *Proportionality Under International Humanitarian Law: The Reasonable Military Commander Standard and Reverberating Effects*, 51 VAND J TRANSNAT’IL R 835, 848 (2018).

¹⁷ *Urban Warfare and New Technologies: Challenges to Humanitarian Law and Action*, INT’L COMM. RED CROSS (July 6, 2009), <https://www.icrc.org/en/document/evolution-or-warfare-challenges-posed-technological-advances-humanitarian-action-and>; see generally, Mark Zeitoun & Michael Talhami, *The Impact of Explosive Weapons on Urban Services: Direct and Reverberating Effects Across Space and Time*, 98 INT’L REV. RED CROSS 53 (2016), for discussion on reverberating effects

largely absent from academia.¹⁸ Second, it is this author's opinion that the literature surrounding reverberating effects does not give due regard to the practical realities of warfare. Ultimately, this paper contends that while there are significant arguments that environmental reverberations are currently considered by conflict parties, extensive scientific limitations suggest this may not be occurring in practice. It further advises against including environmental reverberations in proportionality calculations. However, militaries cannot ignore reverberating effects in their operations. Rather, the impact of reverberating effects is only constrained by political factors and the threshold of maximum environmental harm.

Part II of this paper explains environment reverberations and their place in the IHL system. In particular, it defines the natural environment and emphasizes the significant threat posed by collateral damage. It argues that the proportionality principle is a core rule in protecting the environment against collateral damage.

Part III of this paper explores arguments in favor of including reverberating effects and environmental reverberations in particular. Commentators argue that the article 51(5)(b) is not explicitly limited to direct effects. Rather, a purposive interpretation favors their inclusion. They therefore argue that when reverberating effects are expected conflict parties are obliged to consider them. For environmental reverberations, case law appears to be open to considering environmental reverberations, though it is not authoritative on this point. Secondly, it is purported that conflict parties are under a legal duty to constantly take care to prevent the extensive environmental harm. Arguably, this requirement to care obliges parties to take reverberations into account.

Part IV of this paper thematically critiques these proposals, finding no legal obligation for including reverberating effects. First, it finds that the current literature on reverberations is generally not representative of a balanced debate. Largely absent from the debate has been the consideration of militaries. Including reverberating effects may restrict a military's ability to achieve its objective, expose troops to further harm and prolong conflicts. Second, this paper finds that including reverberating effects introduces considerable complexity and ambiguity into proportionality calculations. Third, reverberating effects wrongly attribute victim failings to the attacking state. Finally, conflict parties need substantial information and expertise resources to be able to properly anticipate reverberating effects. However, not all militaries will have these capabilities.

in urban areas; Christina Wille, *The Implications of the Reverberating Effects of Explosive Weapons Use in Populated Areas for Implementing the Sustainable Development Goals*, U.N. INSTITUTE FOR DISARMAMENT RESEARCH (2016), <https://undir.org/publication/implications-reverberating-effects-explosive-weapons-use-populated-areas-implementing>; see generally, Eric Talbot Jensen, *Unexpected Consequences from Knock-On Effects: A Different Standard for Computer Network Operations?* 18 AM. U. INT'L L. REV. 1145 (2003), for a discussion on reverberating effects in cyber-attacks.

¹⁸ Christina Wille & John Borrie, *Understanding the Reverberating Effects of Explosive Weapons: A Way Forward*, U.N. INSTITUTE FOR DISARMAMENT RESEARCH (2016) at 2. <https://undir.org/publication/understanding-reverberating-effects-explosive-weapons-way-forward>.

II. ENVIRONMENTAL REVERBERATIONS

A. Defining the Natural Environment

The terms “environment” and “natural environment” are often used interchangeably in IHL without a universally accepted definition.¹⁹ Most literature suggests that natural environment should be interpreted as broadly as possible. Commentary to the Additional Protocols to the Geneva Convention indicates that the natural environment should be understood in its widest sense to cover the biological natural environment in which a population is living. This includes forests, fauna, flora and other biological and climatic elements.²⁰ Another commonly cited definition is provided in the ENMOD convention which defines natural environmental modification techniques as “any technique for changing – through the deliberate manipulation of natural processes – the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space.”²¹

Similarly broad definitions have been used in the by the Security Council (hereafter “SC”)²² and the ICJ.²³ Some definitions include cultural heritage elements.²⁴ Given the different considerations cultural elements raise, this paper will not include culture heritage in its definition.

The natural environment is vital for the success of humanity. It “represents the living space, the quality of life and the very health of human beings, including generations unborn.”²⁵ Schmitt contends the concept of the “environment” also extends to its usability.²⁶ The importance of the environment to people further extends beyond mere necessities, encompassing economic, cultural, scientific and religious benefits. This is particularly so for indigenous peoples. For example, in *Rio Negro Massacres v Guatemala* the Inter-American Court of Human Rights described natural resources as an “integral component of the cosmovision, religious

¹⁹ Eric Talbot Jensen, *The International Law of Environment Warfare: Active and Passive Damage during Armed Conflict*, 38 VAND. J. TRANSNAT’L L. 145, 150–52 (2005).

²⁰ *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949* (Yves Sandoz et al. eds., 1987) 27 INT’L REV. RED CROSS 130, 662, ¶ 2126.

²¹ Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, art. II, *opened for signature* May 18, 1977, 1109 U.N.T.S. 152 (*entered into force* Oct. 5, 1978).

²² See S.C. Res. 678, (Nov 29, 1990).

²³ *Legality of Nuclear Weapons Case*, *supra* note 7, ¶ 29.

²⁴ E.g., U.S. Dep’t of Army, Field Manual 3-34.5, Environmental Considerations, ¶¶ 1–4 (Aug. 10, 2015).

²⁵ *Legality of Nuclear Weapons Case*, *supra* note 7, ¶ 29.

²⁶ Michael N Schmitt, *Green War: An Assessment of the Environmental Law of International Armed Conflict*, in *ESSAYS ON LAW AND WAR AT THE FAULT LINES* 361, 366 (T.M.C. Asser Press, 2012).

beliefs, and consequently, their cultural identity.”²⁷ The natural environment is crucial for fulfilling people’s rights²⁸ and plays a core role in United Nations’ sustainable development goals.²⁹ Some regions and scholars consider people to have a right to a healthy natural environment.³⁰

Prior to the Vietnam War, IHL was deeply anthropocentric.³¹ It did not consider the role of the natural environment *per se*.³² Rather, the natural environment only enjoyed coincidental protection, largely through being state property.³³ This conception of the natural environment is still reflected in law today. IHL *prima facie* categorizes the natural environment as a civilian object.³⁴ This is a consequence of the negative application of article 52(2) of the Additional Protocol I to the Geneva Convention (hereafter “API”) which provides that “military objectives are limited to those objectives which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage.”³⁵

Some scholars have questioned whether this categorization is appropriate. They argue that the nebulous character of the natural environment makes it difficult to consider as an object *per se*.³⁶ Rather, the principle of distinction applies to the natural environment outside of the military-civilian dichotomy. The Rome Statute arguably supports such a narrative, referring to the natural environment as distinct from civilian objects.³⁷

²⁷ *Río Negro Massacres v. Guatemala*, Preliminary Objection, Merits, Reparations and Costs, Judgment, Inter-Am. Ct. H.R. (ser. C) No. 250, at 67, n. 266 (Sept. 4, 2012).

²⁸ *E.g.*, *Öneriyildiz v Turkey*, 2005-XII Eur. Ct. H.R. 657, on the right to life.

²⁹ G.A. Res. 70/1, at prml., Transforming our World: The 2030 Agenda for Sustainable Development (Oct. 21, 2015).

³⁰ *E.g.*, African Charter on Human and Peoples’ Rights, art. 24, *opened for signature* June 27th, 1981, 1570 U.N.T.S. 217 (*entered into force* Oct. 21st, 1986); *see also*, Jonathan Watts, *UN Moves Towards Recognising Human Right to a Healthy Environment*, THE GUARDIAN (March 9, 2018) <https://www.theguardian.com/environment/2018/mar/09/un-moves-towards-recognising-human-right-to-a-healthy-environment>.

³¹ Antoine Bouvier, *Protection of the Natural Environment in Time of Armed Conflict*, 285 INT’L REV. RED CROSS 438 (1991); Schmitt, *supra* note 26, at 368–69.

³² Schmitt, *supra* note 26, at 369.

³³ *E.g.*, Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field, art. 50, *opened for signature* August 12, 1949, 75 U.N.T.S. 31 (*entered into force* Oct. 21, 1950).

³⁴ *War Torn Environment*, *supra* note 34, at 300.

³⁵ *AP I*, *supra* note 6, art. 52.

³⁶ *See e.g.*, Jérôme de Hemptinne, *The Protection of Animals During Warfare*, 111 AM. SOC’Y INT’L L. 272, 274 (2017).

³⁷ Rome Statute of the International Criminal Court, art. 8(2)(b)(iv), *opened for signature* July 17, 1998, 2187 U.N.T.S. 3 (*entered into force* July 1, 2002) [hereinafter *Rome Statute*].

However, the prevailing academic view is that the natural environment is a civilian object.³⁸ Article 55 which is specifically designed to protect the natural environment is situated under the heading “civilian objects”.³⁹ IHL therefore applies a strict binary approach to military objects and civilian objects; the natural environment is either one or the other. The practice and statements of states do not suggest otherwise.⁴⁰

The need to protect the natural environment from armed conflict has been increasingly recognized by the international community.⁴¹ Some now advocate for its protection by virtue of its existence rather than its human benefit. For example, the World Charter for Nature, which was adopted in 1983 by almost unanimous consent of the United Nations General Assembly obliges that “[n]ature shall be secured against degradation caused by warfare or other hostile activities”⁴² and in doing so recognizes that “[e]very form of life is unique warranting respect regardless of its worth to man, and to accord other organisms such recognition, man must be guided by moral code of action.”⁴³

While some scholars continue to regard IHL as anthropocentric,⁴⁴ others indicate the law is moving towards an “intrinsic” value.⁴⁵ Arguably, an anthropocentric approach is better for IHL as a specific area of law, as “intrinsic value” considerations may conflict with humanitarian concerns.⁴⁶ Further, it maintains a similar value paradigm across IHL considerations, such as humanitarian and military necessity.⁴⁷

B. Protecting the Environment from Collateral Damage

³⁸ Tara Smith, *The Prohibition of Environmental Damage during the Conduct of Hostilities in Non-International Armed Conflict* (unpublished Ph.D. thesis, Nat'l U. Ireland Galway, May 9, 2013) at 88–89.

³⁹ Karen Hulme, *Taking Care to Protect the Environment Against Damage: A Meaningless Obligation?*, 92 INT'L REV. RED CROSS 675, 678 (2010).

⁴⁰ Cordula Droegge and Marie-Louise Tougas, *The Protection of the Natural Environment in Armed Conflict - Existing Rule and Need for Further Legal Protection*, 82 NORDIC J. INT'L L. 21, 26 (2013).

⁴¹ See e.g., U.N. Conference on the Human Environment, *Stockholm Declaration*, A/Conf.48/14 (June 1972); G.A. Res. 37/7, *World Charter for Nature* (Oct. 28, 1982); U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26/Rev.1 (Vol. I), annex I, princ. 24 (Aug. 12, 1992).

⁴² G.A. Res. 37/7, princ. 5, *World Charter for Nature* (Oct. 28, 1982).

⁴³ *Id.* at pmb1.

⁴⁴ Michaela Halpern, *Protecting Vulnerable Environments in Armed Conflict: Deficiencies in International Humanitarian Law*, 51 STAN. J. INT'L L. 119, 141 (2015).

⁴⁵ John Alan Cohan, *Modes of Warfare and Evolving Standards of Environmental Protection under the International Law of War*, 15 FLA. J. INT'L L. 481, 484 (2003); Schmitt, *supra* note 26, at 465.

⁴⁶ See Cohan, *supra* note 45, at 506–07, for hypotheticals on this point; Schmitt, *supra* note 26, at 467.

⁴⁷ Schmitt, *supra* note 26, at 465–66.

Environmental harm is an inevitable and inseparable consequence of armed conflict. Warfare's ability to harm the natural environment is multifaceted.⁴⁸ For example, it can be intentionally harmed, through scorched Earth policies,⁴⁹ or it can be collaterally harmed. This paper focuses exclusively on the collateral damage caused by military attacks.

Most of the environmental harm caused by military attacks are reverberating effects.⁵⁰ As Schmitt describes the scope of reverberating effects is larger for the environment as "its very essence is interconnectedness."⁵¹ Because of this, environmental reverberations tend to have longer chains of causation.⁵² For example, the contamination of a river can negatively impact the health and demographics of aquatic populations. This can, in turn, threaten the survival of species.⁵³ Consequently, seemingly negligible direct effects can reverberate into excessive environmental harm.⁵⁴ Further, environmental reverberations pose a significant threat as the impact that cause can often be irreversible: "[t]hus, unlike most other damage in warfare, environmental devastation truly may represent crossing the Rubicon of survival."⁵⁵

One type of environmental reverberation is air, soil, and water contamination. Where military attacks cause such contamination it can have negative effects on the health of nearby populations, natural resources (such as drinking water and arable land), and flora, fauna and their wider ecosystems.⁵⁶ For example, in the 2006 Lebanon war NATO destroyed the El Jiyeh power station. As a result of the attack approximately 75,000 cubic meters of oil burned, spilled into the sea, and leaked into the ground. The fires created atmospheric pollution, which is thought to have negatively impacted the health of nearby communities.⁵⁷ The oil contaminated water causing subsequent harm to marine life, including in two nature reserves, and had potential to impact groundwater wells and aquifers.⁵⁸

The environment can also be indirectly impacted through the explosive remnants of war ("ERWs"), such as landmines and cluster munitions that remain following an attack. ERWs contaminate land, threatening the safety of both people

⁴⁸ See generally Jensen, *supra* note 19.

⁴⁹ See Hostage Case, U.S. v. List (Wilhelm) Case No 7, Ors., Trial Judgment, 11 T.W.C. 757 (1950), in facts for an example.

⁵⁰ See Wille, *supra* note 17; see Schmitt, *supra* note 26, at 463.

⁵¹ Schmitt, *supra* note 26, at 463.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ Droege & Tougas, *supra* note 40, at 31

⁵⁵ Schmitt, *supra* note 26, at 463–64.

⁵⁶ See Lee & Hains, *supra* note 1

⁵⁷ U.N. Env't Programme, *Lebanon: Post-Conflict Environmental Assessment*, at 44–46 (Jan. 01, 2007) [hereinafter *UNEP, Lebanon*].

⁵⁸ See *id.*

and fauna.⁵⁹ As a result, agricultural land may become unusable. This can in turn lead to other agricultural areas being over-grazed and degraded as a result.⁶⁰

Environmental harm can be also caused by reverberations through infrastructure. As seen in the 1991 Gulf War, the damage or the loss of electricity to water and wastewater infrastructure lead to water and soil contamination and consequent health concerns.⁶¹ It can also contaminate agricultural land, rendering it unusable. For example, in the 2008 Gaza Strip conflict the Az Zaitoun wastewater treatment plant was attacked, causing the spillage of 100,000 cubic meters of mostly untreated wastewater and sewage sludge over 55,000 square meters of agricultural land.⁶² Further, the loss of electricity also can lead to other environmental impacts. For example, in Donetsk the loss of electricity caused the ventilation systems and water pumps in several coal mines to fail. Toxic gases were released and the mines were flooded, polluting groundwater.⁶³

Military attacks can also impact biodiversity and ecological systems.⁶⁴ Loss of habitat and food sources can lead to changes in behavior and population decrease that can, in turn, affect other species. This is a particular threat for fragile ecosystems, like the desert ecosystem in Iraq⁶⁵ and for threatened species.

Finally, military attacks can also indirectly lead to broader environmental consequences. Loss of infrastructure, natural resources and use of arable land can encourage populations to adopt unsustainable practices and intensify resource exploitation for the purpose of meeting short term needs.⁶⁶ Warfare can stall environmental and conservation efforts and can allow for poaching.⁶⁷ Military attacks can displace populations. Forced migration during part conflicts has caused enormous strain on the natural environment as refugees exploit natural resources, including fauna, destroy vegetation and contaminate land and water due to improper sanitation infrastructure.⁶⁸

C. The Legal Framework

⁵⁹ See U.N. Env't Programme, *Afghanistan: Post-Conflict Environmental Assessment*, (Sept. 22, 2003).

⁶⁰ U.N. Env't Programme, Lebanon, *supra* note 56, at 150, 155; Jennifer Dathan, *When the Bombs Fall Salient – The Reverberating Effects of Explosive Weapons*, at 22–25 (Iain Overton ed., May 2018), <https://aoav.org.uk/wp-content/uploads/2018/06/Reverberating-effects-v5.pdf>.

⁶¹ Lee & Hains, *supra* note 1, at 304.

⁶² U.N. Env't Programme, *Environmental Assessment of the Gaza Strip Following the Escalation of Hostilities in December 2008–January 2009*, at 79 (Sept. 14, 2009).

⁶³ See e.g., Wille, *supra* note 17, at 15.

⁶⁴ See Michael J. Lawrence et al, *The Effects of Modern War and Military Activities on Biodiversity and the Environment*, 23 *Env't Rev.* 443 (Sept. 17, 2015).

⁶⁵ U.N. Env't Programme, *UNEP in Iraq: Post-Conflict*, at 22 (Dec. 2007) [hereinafter *U.N. Env't Programme, Iraq*].

⁶⁶ U.N. Env't Programme, Lebanon, *supra* note 56, at 155.

⁶⁷ *Id.* at 158.

⁶⁸ Dathan, *supra* note 60, at 27.

It is well accepted that the principle of proportionality applies to protect the natural environment.⁶⁹ In addition, the Rome Statute establishes individual criminal liability where an attack is launched in the knowledge that it will cause widespread, long-term, and severe damage to the natural environment clearly excessive for the anticipated military advantage.⁷⁰ This paper argues that the proportionality principle is crucial in protecting the natural environment from collateral damage. While IHL has created specific environmental protections, these rules have proved to be of little use for protecting against most collateral damage. They apply only in restrictive circumstances and permit extensive destruction.⁷¹ Consequently, the principle of proportionality continues to play an active role in securing the natural environment. Indeed, Schmitt describes proportionality as the “heart of environmental protection.”⁷²

Article 35(3) in AP I prohibits conflict parties from using methods or means of warfare that are intended or expected to cause “widespread, long-term, and severe” damage to the natural environment.⁷³ Article 55 further obliges conflict parties to take care to protect the natural environment against such damage.⁷⁴ However, the applicability of these rules is significantly limited by its cumulative requirements. While what constitutes these adjectives is open to interpretation,⁷⁵ the threshold of permissible natural environment damage has often been described as capturing only effects of a “catastrophic magnitude.”⁷⁶ For example, similar terminology in the ENMOD provision has been interpreted as required damage over several hundred square kilometers and a period of months or a season. It must cause a “serious or significant disruption or harm to human life, natural and economic resources or other assets.”⁷⁷ Other commentary suggests that AP I may have a

⁶⁹ JEAN-MARIE HENCKAERTS & LOUISE DOSWALD-BECK, CUSTOMARY INTERNATIONAL HUMANITARIAN LAW 143 (Vol. 1, reprint 2009); *Legality of Nuclear Weapons*, *supra* note 7; *NATO Bombing Case*, *supra* note 9, at ¶¶ 18–25.

⁷⁰ Rome Stat. Art. 8(2)(b)(iv).

⁷¹ U.N. Env't Programme, *Protecting the Natural Environment During Armed Conflict: An Inventory and Analysis of International Law* at 12 (2009).

⁷² Michael N Schmitt, *War and the Environment: Fault Lines in the Prescriptive Landscape* 37(1) *Archiv des Völkerrechts* 25 at 35 (1999); *see* Hulme, *supra* note 39, at 678 (“the recognition of the environment as a *prima facie* civilian object has done more to protect it than any environmentally specific rule of international humanitarian law”).

⁷³ AP I, *supra* note 6, at art 35(3); *see* HENCKAERTS & DOSWALD-BECK, *supra* note 69, at 147.

⁷⁴ AP I, *supra* note 6, at art 35(3); *see* HENCKAERTS & DOSWALD-BECK, *supra* note 69, at 147.

⁷⁵ Richard Desgagné, *The Prevention of Natural environmental Damage in Time of Armed Conflict: Proportionality and Precautionary Measures*, 3 YEARBOOK OF INT'L HUMANITARIAN L. 109, 112 (Dec. 2000).

⁷⁶ *Id.* at 113; *see also* Michael Bothe et. al. *International Law Protecting the Environment During Armed Conflicts: Gaps and Opportunities* 92 *Int'l Rev. of the Red Cross* 569, 576 (Sept. 2010).

⁷⁷ Bothe et. al., *supra* note 75, at 572.

higher threshold, potentially requiring damage to spread to 20,000 square kilometers, and exist for decades.⁷⁸

Commentators have expressed deep concern that the threshold is too high.⁷⁹ Arguably, environmental damage that does not meet this threshold can still be severe. To date, no conflict party has been found liable for breaching this prohibition. While the international community expressed deep concern for the bombing of El Jyieh power plant, no comment was made on potential IHL violations.⁸⁰ The most disastrous environmental catastrophe caused by armed conflict is the burning of the Kuwaiti oil wells in the 1991 Gulf War. An estimated six to eight million barrels of oil was spilled into the Gulf. This had significant impacts for marine and bird life.⁸¹ Further, atmospheric pollution posed a health threat for nearby communities.⁸² While Iraq was found liable for environmental harm and forced to pay compensation, this liability was a result of *jus ad bellum* violations, rather than a breach of IHL.⁸³

Other IHL rules apply to protect the natural environment in specific circumstances. For example, restrictions on attacks on installations containing dangerous forces exhaustively applies to dams, dykes, and nuclear electrical generating stations.⁸⁴ It therefore does not apply to other infrastructure capable of releasing environmental contaminants, such as oil refineries. Further, the utility of this provision is limited by an exception that installations can be targeted where they are used in “regular, significant and direct support” of military operations and their attack is the only feasible way to terminate such support.” Similarly, the prohibition on removing or rendering useless objects that are indispensable to the human survival is limited and can be overridden where these objects directly support military activity.⁸⁵ Restrictions on the means and methods of warfare, especially those relating to chemical and biological weapons, also indirectly help protect the natural environment.

Finally, it must be noted that there is still potential for international environmental law (“IEL”) obligations to protect the natural environment during armed conflicts. The scope of this however is unclear. The International Law

⁷⁸ *War Torn Environment*, *supra* note 34, at 92–95 in assessing the *travaux préparatoires* of the API.

⁷⁹ U.N. Env’t Programme Protecting the Natural Environment, *supra* note 71, at 41; *see also* Bothe et. al. *supra* note 76, at 576.

⁸⁰ G.A. Res. 74/208, ¶¶ 1–3 (Dec. 19, 2019).

⁸¹ Makram A Gerges, *On the Impacts of the 1991 Gulf War on the Environment of the Region: General Observations*, 27 MARINE POLLUTION BULL. 305, 305–311 (1993).

⁸² *Id.* at 312.

⁸³ *See*, S.C. Res. 678, (Nov. 29, 1990).

⁸⁴ *See e.g.*, HENCKAERTS & DOSWALD-BECK, *supra* note 69, at 139; *see* AP I, *supra* note 6, at art 56, art 85(3)(c); *see* Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of Non-International Armed Conflict (Protocol II) art. 15, 1125 UNTS 3 (opened for signature 8 June 1977, entered into force 7 December 1978).

⁸⁵ AP I, *supra* note 6, at art. 54(2); HENCKAERTS & DOSWALD-BECK, *supra* note 69, at 191–92.

Commission produced a list of IEL treaties susceptible of continuing to operate during armed conflicts.⁸⁶

III. PROPOSALS FOR INCLUDING REVERBERATING EFFECTS

Given the dominant role the proportionality principle plays in protecting the natural environment, the proper scope of collateral environment harm to be calculated in the principle is an important matter. Including environmental reverberations gives greater weight to the quantified collateral damage. This next section first describes possible theories for including reverberating effects generally. Second, it describes theories for including environmental reverberations in particular.

A. Advocacy for Reverberations Generally

A significant amount of legal commentary now contends that reverberating effects are legally required to be considered.⁸⁷ Other scholars describe the law as unclear.⁸⁸ Rather than contend new customary law, those advocating for the inclusion of reverberating effects appear to suggest that the proper application of the proportionality principle constitutes inclusion of reverberating effects.⁸⁹ This section will describe their arguments.

Commentators are motivated to include reverberating effects to ameliorate harm to civilians and civilian objects. “In essence, humanitarians are suggesting that the concept of collateral damage be broadened to keep pace with weapons technology and societal change.”⁹⁰ More precise weapons have further brought down permissible levels of collateral damage.⁹¹ Reverberating effects pose a significant humanitarian concern. Increased urbanization and dependency on social infrastructure means civilians are susceptible to reverberations. Indeed, direct deaths and injury appear to be just the “tip of the iceberg” in harm caused by military

⁸⁶ G.A., 63rd Sess., Report of the International Law Commission, Supp. No. A/66/10 (2011).

⁸⁷ See TALLINN MANUAL, *supra* note 11, at 472 (in relation to cyber-attacks); see generally Robinson & Nohle, *supra* note 14 (in relation to kinetic attacks).

⁸⁸ MAX PLANCK FOUNDATION FOR INTERNATIONAL PEACE AND THE RULE OF LAW, THE LAW OF ARMED CONFLICT AND THE USE OF FORCE: THE MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW, 1057 (Frauke Lachenmann & Rüdiger Wolfrum eds., online ed, Oxford University Press, 2017).

⁸⁹ ICRC Q&A, *supra* note 10, at 104–105.

⁹⁰ Crawford, *supra* note 2, at 106.

⁹¹ Richard Gross et. al., *Interpretive Complexity and the International Humanitarian Law Principle of Proportionality*, American Society of International Law. Proceedings of the Annual Meeting at 88 (Apr. 7, 2014), <https://www.proquest.com/docview/1677185722/fulltext/E22A6B0F7DE744E0PQ/1?accountid=8360>.

attacks.⁹² They prevent the fulfillment of sustainable development goals and impact human rights.⁹³ Including reverberations adds weight to the amount of quantified collateral damage, theoretically increasing the likelihood that an attack may be found to be disproportionate.

Advocates also express concern that by including only direct effects, conflict parties can circumvent the principle of distinction and knowingly inflict harm on civilians and civilian objects. For example, attacks on the electrical grids can have dual purposes: to cripple key elements military systems and to weaken civilian support for the war.⁹⁴ Limiting applicable collateral damage to direct effects, allows conflict parties to include the likely impact of indirect collateral damage in their military strategy, while simultaneously failing to incorporate such harm into proportionality calculations.⁹⁵ Consequently, dual use targets may become more attractive to conflict parties who believe they can doubly benefit from the damage done to the military and to the civilian population.⁹⁶

Further, including reverberating effects will positively oblige conflict parties to mitigate the harm reverberations cause. AP I obliges conflict parties to take “constant care” to spare civilians and civilian objects, including to taking all feasible precautions to avoid and in any event minimize, collateral damage.⁹⁷ The ICRC contends this is customary law.⁹⁸ “Feasible precautions” are those that are “practicable or practically possible” in the circumstances at the time of the attack.⁹⁹ If “incidental loss of civilian life, injury to civilians and damage to civilian objects”¹⁰⁰ is not limited to direct effects, conflict parties are obliged to take feasible precautions to prevent or mitigate the impact of reverberating effects. For example, carbon graphite filaments may be used to temporarily disable power rather than destroying the infrastructure.¹⁰¹

Advocates argue the inclusion of reverberating effects is open on the text of article 51(5)(b) and is the proper interpretation. They contend that if only direct effects were to be considered, the word “direct” would have quantified incidental damage.¹⁰² However, no such qualification appears for incidental damage. By contrast, the article’s text explicitly limits permissible military advantages to those

⁹² Wille & Borrie, *supra* note 18, at 20; *see* Robinson & Nohle, *supra* note 14, at 108 (for similar comments).

⁹³ Wille, *supra* note 17, at 2.

⁹⁴ Crawford, *supra* note 2, at 101, 109.

⁹⁵ Jefferson D Reynolds, *Collateral Damage on the 21st Century Battlefield: Enemy Exploitation of the Law of Armed Conflict and the Struggle for a Moral High Ground*, 53 AIR FORCE L. REV. 90, 91 (2005).

⁹⁶ HEATHER HARRISON DINNISS, *CYBER WARFARE AND THE LAWS OF WAR* 195 (Cambridge, Cambridge University Press, 2012).

⁹⁷ AP I, *supra* note 6, at Art. 57(1).

⁹⁸ ICRC customary law study, *supra* note 69, at rule 15.

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ Henry Shue & David Wippman, *Limiting Attacks on Dual-Use Facilities Performing Indispensable Civilian Function*, 35 CORNELL INT’L L. J., 559, 565 (2002).

¹⁰² Robinson & Nohle *supra* note 14, at 113–14; *see also* Henderson & Reece, *supra* note 16, at 850–51.

that are “concrete and direct.”¹⁰³ While this argument is compelling, it does not take into account that the attacking party must “cause” the incidental harm. As will be argued at length later, this could limit the applicability of the text to direct effects only.

Academics further contend that a purposive interpretation favors including reverberating effects. Treaties are to be interpreted in good faith and in accordance with the ordinary meaning to be given to the terms of the treaty. This is to be assessed in light of their context, object, and purpose.¹⁰⁴ Advocates contend that article 51(5)(b) should be interpreted in light of the heading of the article 51, namely “Protection of the Civilian Population” and the governing article 57(1) which provides that “in the conduct of military operations, constant care shall be taken to spare the civilian population, civilians and civilian objects.”¹⁰⁵

Advocates further point toward the preamble of the Protocol which states that contracting parties believe it is necessary to “reaffirm and develop the provisions protecting the victims of armed conflicts.” Several scholars contend that in light of this humanitarian purpose, the broadest possible protection of civilians should be adopted. This includes the incorporation of reverberations in proportionality calculations.¹⁰⁶ In addition, Robinson and Nohle find that other articles within API and other conventions suggest reverberating effects are included. For example, they opine that articles 54(2) and 56(1) prohibit attacks on specifically protected objects because of the foreseeable humanitarian impact that would indirectly follow such objects being damaged or destroyed.¹⁰⁷

Based on this interpretation, advocates argue that reverberating effects can be included where they fulfill the explicit requirement of article 51(5)(b): namely, where they are effects that “may be expected” to arise. Advocates maintain this limitation adequately limits the scope of reverberating effects to make the principle practically applicable.¹⁰⁸ Some critics have wrongly ignored this point. For example, Major General (ret.) Ayres and Lieutenant Colonel Thurnher expressed concern that some conflict parties will be “held accountable for every third-order effect and *unexpected* long-term consequences of their actions in urban areas.”¹⁰⁹ Such an interpretation is not available on the treaty text. The requirement that effects must be “expected” explicitly limits the type of third-order effects permissible and excludes unexpected effects.

¹⁰³ Int’l L. Ass’n Study Group, *The Conduct of Hostilities and International Humanitarian Law: Challenges of 21st Century Warfare*, 93 INT’L L. STUD. 322, 344 (2017).

¹⁰⁴ 1155 U.N.T.S. 331 (May 23, 1969).

¹⁰⁵ *Id.*

¹⁰⁶ Robinson & Nohle, *supra* note 14, at 114; *see also* Henderson & Reece, *supra* note 16, at 851–52.

¹⁰⁷ Robinson & Nohle, *supra* note 14, at 114–15.

¹⁰⁸ Henderson & Reece, *supra* note 16, at 855–56.

¹⁰⁹ Major General (ret.) Thomas E Ayres and Lieutenant Colonel Jeffery S Thurnher, *Legitimacy: The Lynchpin of Military Success in Complex Battlespaces*, in COMPLEX BATTLESPACES: THE LAW OF ARMED CONFLICT AND THE DYNAMICS OF MODERN 255 (Christopher M. Ford and Winston S. Williams, Oxford, Oxford University Press, 2018) (emphasis added).

The requirement “may be expected” is believed to be objectively assessed with reference to the subjective circumstances of the deciding commander. The ICTY in *Galić* stated in assessing proportionality it is necessary to examine whether a “reasonably well-informed person in the circumstances of the actual perpetrator, making reasonable use of the information available to him or her, could have expected excessive civilian casualties to result from the attack.”¹¹⁰

By contrast, the ICTY in the *NATO Bombings Case* suggests a higher threshold of “reasonable military commander.” The assessment is still based on the deciding commander’s subjective circumstances. The reasonable military commander requirement does not specify the status of the decision-maker. Rather it requires that the reasonability is assessed with a commander’s degree of operational expertise. Advocates contend that this higher threshold means that some reverberating effects will be reasonably foreseeable. As Sassòli and Cameron suggest while the reasonable person may not be able to foresee the effect destroying electrical infrastructure would have on fresh water supply, a reasonable military commander who has greater understanding of infrastructure will.¹¹¹

Advocates suggest that in light of available information some reverberating effects are “objectively foreseeable.” In particular, look to accumulations of past practices, empirical research, lessons learned from other conflicts, and publicly available information.¹¹² Indeed, several scholars appear to suggest that some environmental reverberations are objectively foreseeable. These suggestions include the long-term contamination of nuclear weapons,¹¹³ contamination from ERWS,¹¹⁴ and contamination and pollution from damage to wastewater infrastructure, including even where it leads to “polio one year down the road.”¹¹⁵ The British Military Manual provides that if an attack on a military fuel storage depot is planned, the commander must consider whether burning flow is expected to flow into civilian residential areas and likely injury to civilians.¹¹⁶

B. Environmental Reverberations

¹¹⁰ *Prosecutor v Stanislav Galić* (Judgment and Opinion of the International Tribunal for the Prosecution of Persons Responsible for Serious Violations of International Humanitarian Law Committed in the Territory of the Former Yugoslavia (ICTY)) Case No. IT-98-29-T (5 September 2003) at ¶ 58.

¹¹¹ Marco Sassòli & Lindsey Cameron, *The Protection of Civilian Objects: Current State of the Law and Issues de Lege Ferenda*, in *THE LAW OF AIR WARFARE: CONTEMPORARY ISSUES* 54 (Natalino Ronzitti & Gabriella Venturini eds., Eleven International Publishing, Utrecht, 2006).

¹¹² Robinson & Nohle, *supra* note 14, at 122.

¹¹³ *Id.*

¹¹⁴ Working Paper submitted by the ICRC, CCW/GGE/XI/WG.1/WP.7 (Geneva, 2005), 21.

¹¹⁵ Daniel Cahen, *The Effectiveness of International Law* (2014) 108 Proceedings of the Annual Meeting (American Society of International Law), 92.

¹¹⁶ UNITED KINGDOM JOINT DOCTRINE AND CONCEPTS CENTRE, *THE JOINT SERVICE MANUAL OF THE LAW OF ARMED CONFLICT* ¶ 5.33.4 (383 JSP, 2004).

There are also additional arguments that suggest that environment reverberations *in particular* should be included in proportionality calculations. First, several cases appear to consider long-term environmental effects in assessing the proportionality principle. Second, it has been suggested that the obligation on conflict states to take care in protecting the natural environment against “widespread, long-term and severe damage” requires that long-term, indirect effects be considered under the proportionality principle.

The concept of environmental harm in IHL is complex and is often legally used without uniformity.¹¹⁷ No IHL instruments provide a definition on environmental harm, even though both the AP I and Rome Statute use the term “damage to the natural environment.” The *travaux preparatoires* show considerable debate on the issue, with states concerned that a low threshold may create wide application. The documents indicate a focus on “disturbing the stability of the environment.”

In the *Final Report to the Prosecutor by the Committee Established to Review the NATO Bombing Campaign Against the Federal Republic of Yugoslavia* (“Report on the NATO Bombing”) the Committee Established to Review the NATO Bombing Campaign Against the Federal Republic of Yugoslavia (here after “the Committee”) appeared to be open to including the contamination and population and their effect on people, flora, and fauna in its analysis of the proportionality principle. Ultimately however the Committee chose not to commence an investigation into the collateral environmental damage caused by the NATO bombing campaign and so did not decide on this point.¹¹⁸ This was, in part, because it did not consider the damage to *prima facie* to amount to the threshold of “widespread, long-term and severe” under article 35(3) of AP I.¹¹⁹ In making this preliminary assessment, the committee considered the findings of the Balkan Task Force which had been established to evaluate the harm caused.¹²⁰ The Force found the conflict did not cause “an environmental catastrophe.” In reaching this conclusion, the Force referred to environmental reverberations, for example, including assessments of the likely impact at a species and ecological level.¹²¹ Further, the Committee appeared to indicate that it would consider long-term harms. In expressing that its findings were constrained by limited information, the Committee stated “it is quite possible that, as this campaign occurred only a year ago, the UNEP study may not be a reliable indicator of the long-term environmental consequences of the NATO bombing, as accurate assessment regarding the long-term effects of this contamination may not yet be practicable.”¹²²

¹¹⁷ *War Torn*, *supra* note 34, at 17

¹¹⁸ *NATO Bombing Report*, *supra* note 9, at ¶ 25.

¹¹⁹ *Id.* ¶ 17.

¹²⁰ *Id.* ¶ 16.

¹²¹ UNCHS, *THE KOSOVO CONFLICT: CONSEQUENCES FOR THE ENVIRONMENT AND HUMAN SETTLEMENTS 68* (United Nations Environment Programme and United Nations Centre for Human Settlements (Habitat), 1999).

¹²² *NATO Bombing Report*, *supra* note 9, ¶ 17.

Similarly, the *Legality of Nuclear Weapons Case* stated that the “unique characteristics” of nuclear weapons were to be considered in applying the law.¹²³ These characteristics included the indirect effects of radiation on “health, agriculture, natural resources and demography over a very wide area” and that “[i]onizing radiation has the potential to damage the future environment, food and marine ecosystem and to cause genetic defects and illness in future generations.”¹²⁴

Second, scholars have suggested that the text of AP I arguably encourages the inclusion of environmental reverberations. As discussed, party states are obliged to take care in protecting the environment from extensive environmental damage. In particular, article 55 creates a due diligence requirement. It states “[c]are shall be taken in warfare to protect the natural environment against widespread, long-term and severe damage.” This obligation of “care” is also purported to be customary law. The ICRC customary law study provides “Methods and means of warfare must be employed with due regard to the protection and preservation of the natural environment. In the conduct of military operations, all feasible precautions must be taken to avoid and, in any event, to minimize incidental damage to the environment.”¹²⁵ Hulme contends that the notion of care means approaching the issue of the natural environment with “caution” and “attention,” in their approach to environmental concerns respectively. By contrast, she regards the notion of “due regard” to be a lower threshold and focuses more on balancing competing considerations.¹²⁶

This “care” or “due regard” is an “obligation of conduct,”¹²⁷ whereas, unsurprisingly, the proportionality principle obliges a proportionate result. For Hulme, these due diligence obligations require that “reasonable steps must be taken to avoid widespread, long-term and severe environmental damage.”¹²⁸ She suggests reasonable steps might entail taking positive obligations to avoid or reduce potential damage.¹²⁹ States may have to minimize weaponry, employ different weaponry and tactics, change the objective to be attacked, change the timing of the attack, and ultimately, depending on the level of military advantage, call off the attack.¹³⁰

Arguably, proportionality and the obligation of due regard complement one another. The due regard obligation appears to require a wider consideration of effects as what amounts to “widespread, long-term and severe” is not limited to the direct impacts of an attack. Bothe contends that “[t]he due regard principle means an application of the proportionality principle which does not simply take into

¹²³ *Legality of Nuclear Weapons Case*, *supra* note 7, at 36.

¹²⁴ *Id.* at 35.

¹²⁵ ICRC customary law study, *supra* note 69, Rule 44.

¹²⁶ Hulme, *supra* note 39, at 685.

¹²⁷ *Id.* at 679.

¹²⁸ *Id.* at 680.

¹²⁹ *Id.* at 682.

¹³⁰ *Id.*

account damage in the vanity of a military objective. Due regard is regard for indirect, longer term damage.”¹³¹

However, there are issues with this proposal. Commentators have also expressed concern that despite the optimism of the ICRC, article 55 may not amount to customary law. To support its contention the ICRC points to soft law texts,¹³² international cases, SC and General Assembly resolutions, and military manuals among others which emphasize the importance of the environment and its need for protection in armed conflict.¹³³ By contrast, Wyatt suggests that in light of natural environmental degradation seen in recent conflicts, the natural environmental provisions of AP I may not be customary law.¹³⁴ He finds that most major incidents of post-1980 wartime environmental damage were committed by states not party to the AP I, citing for example, the burning of the Kuwaiti oil wells and the NATO bombings in Kosovo.¹³⁵ If article 55 is not encapsulated in customary law this would significantly limit its application. AP I is not applicable in non-international armed conflicts. Further, the protocol lacks universal ratification. Notably, the United States has signed but not ratified the treaty, meaning they are only obliged to refrain from defeating its objective and purpose. They are not bound to the specific rules and obligations.¹³⁶

Notably, article 55(1) only obliges states to protect the natural environment against damage that is perceived to be “widespread, long-term and severe.”¹³⁷ As discussed, this is an incredibly high threshold that is unlikely to be engaged by most anticipated attacks. It appears that article 55 operates only to emphasize the obligation under article 35(3), that states should not cause “widespread, long-term and severe” damage to the natural environment. Therefore, article 55 only obliges conflict parties to consider environmental reverberations where they believe the collateral damage is likely to exceed the threshold of permissible harm.

IV. PROPOSAL CRITIQUES

Despite these theories, this section shows there are considerable difficulties in including environmental reverberations, and reverberating effects more generally, in proportionality calculations. It finds that while there are

¹³¹ Michael Bothe, Protection of the Natural Environment in and After Armed Conflict: Overview and Trends, Keynote Address: Free University of Berlin, Germany (June 2012).

¹³² Stockholm Declaration of the United Nations Conference on the Human Environment A/Conf.48/14 (1972); World Charter for Nature GA Res 37/3 A/Res/37/51 (1982); Rio Declaration on Natural environment and Development U.N. Docs A/Conf151/Rev.1 (1992), principle 24.

¹³³ See HENACKAERTS & DOSWALD-BECK, *supra* note 69, commentary to rule 44.

¹³⁴ Julian Wyatt, *Law-Making at the Intersection of International Environmental, Humanitarian, and Criminal Law: The Issue of Damage to the Environment in International Armed Conflict*, 879 INT’L REV. RED CROSS 593, 612–613 (2010).

¹³⁵ *Id.* at 612–613.

¹³⁶ 1155 U.N.T.S. 331, art. 18 (May 23, 1969).

¹³⁷ Hulme, *supra* note 39, at 682.

suggestions that environmental reverberations are considered by militaries, there are substantial reasons for why militaries may not wish to include them. These considerations have largely been absent from commentary. In addition, there are considerable difficulties with included environmental reverberations. First, the law is unclear how the foreseeability and causation requirements are to be applied. This is particularly difficult for environment reverberations given that they are often scientifically uncertain. Second, including reverberating effects solely attributes responsibility to the attacking party, even where the victim has control over impacting factors. Finally, properly assessing potential environment reverberations requires considerable information and expertise resources, which militaries may not be able to provide.

Traditionally only direct harm was considered under the proportionality assessment. The majority of case law concerning the proportionality principle addresses only direct civilian deaths and damage to civilian objects. Cases that appear to consider a longer temporal scope for collateral damage or reverberating effects are unclear and have been subsequently criticized. Kupreskic appeared to suggest that cumulatively the effects of multiple attacks may amount to a violation of IHL.¹³⁸ The *Report on the NATO Committee* believed the court intended the formulation to mean that proportionality is “an overall assessment of the totality of civilian victims against the goals of military campaign.”¹³⁹ This suggests a long temporal scope for permissible collateral damage. This approach was rejected in the *Report on the NATO Bombing*.¹⁴⁰

A. Military Considerations

This section finds *prima facie* conflict parties do appear to include environmental reverberations. However, discussions and restrictions regarding ERWs should not be used as evidence of this.

Advocates contend that states do in fact incorporate reverberating effects into their proportionality calculations. For example, Henderson and Reece state that while it could not be said with clarity in 2009 whether reverberating effects were considered, they are not aware of any states that would argue against including reverberating effects.¹⁴¹ By contrast, Dinstein describes the issue of reverberating effects as “a theoretical issue characteristics of academic discourse” that is in practice ignored by states.¹⁴²

Advocates also point to restrictions and discussions surrounding ERWs as “significant state practice.” In the debates concerning the Third Review Conference

¹³⁸ The Prosecutor v Zoran Kupreškić, Mirjan Kupreškić, Vlatko Kupreškić, Drago Josipovic, Dragan Papic and Vladimar Sanctic, Case No. IT-95-16-T, judgement ¶ 526 (14 Jan 2000).

¹³⁹ NATO BOMBING REPORT, *supra* note 9, ¶ 52

¹⁴⁰ *Id.*

¹⁴¹ Henderson & Reece, *supra* note 16, at 849.

¹⁴² Yoram Dinstein, *Remarks by Yoram Dinstein* 108 AMERICAN SOC’Y INT’L L. 85,92 (2014) (discussing the humanitarian law principle of proportionality).

on the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (CCW) several states stressed that foreseeable incidental long-term effects should be considered.¹⁴³ The text of the concluded art 3(10)(a) of Amended Protocol II provides that the relevant circumstances when considering feasible precautions to protect civilians from ERWs include “the short- and long-term effects of mines upon the local civilian population for the duration of the minefield.”¹⁴⁴

It is this author’s opinion that states’ practice regarding ERWs does not support a finding that states include reverberating effects into proportionality calculations. First, the short- and long-term effects ERWs present have a shorter causation line than other reverberations. Second, discussions surrounding ERWs and the text of the Amended Protocol II occurred in the context of a highly politicized campaign to ban landmines. The International Campaign to Ban Landmines (“ICBL”) was a large of non-governmental organizations and some sympathetic states. The ICBL framed the issue of landmines as a public health crisis. This moved the issue from traditional IHL discourse of military needs and put substantial political pressures on states to agree to restrictions, even where their militaries disagreed.¹⁴⁵

Advocates point to military manuals which either explicitly provide that foreseeable reverberating effects are to be taken into account or seem to imply this.¹⁴⁶ Military manuals of the United States suggest that environmental reverberations are included. However, there is an outlier. The United States Department of Defense *Law of War Manual* states that expected loss is generally understood to mean “immediate or direct harms foreseeably resulting from the attack.”¹⁴⁷ Yet, that same document and other US manuals give examples of including reverberating effects.¹⁴⁸ Further, the United States Joint Chief of Staff document provides that for plume and environmental hazards “[s]pecial consideration must be given to the secondary and tertiary effects” they could create, such as “releasing chemical, biological, or radiological clouds into the

¹⁴³ Response from Norway to the Document CCW/GGE/X/WG.1/WP.2 and CCW/GGE/XI/WG.1/WP.5.29, U.N. (August 2005);

Response from Sweden to Document CCW/GGE/X/WG.1/WP.2 and CCW/GGE/XI/WG.1/WP.8, U.N. (March 2005); Third Review Conference on the Use of Certain Convention Weapons, *Declaration on Cluster Munitions*, U.N. Doc. CCW/CONF.III/WP.18 (Nov. 20, 2006).

¹⁴⁴ Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices, *as amended* May 3, 1996, 2048 UNTS 93.

¹⁴⁵ John English, *The Ottawa Process: Paths Followed, Paths Ahead*, 52 AUSTRALIAN J. INT’L. AFF. 121, 124–125 (1998); Kenneth Anderson, *The Ottawa Convention Banning Landmines, the Role of International Non-governmental Organizations and the Idea of International Civil Society*, 11 EUROPEAN J. INT’L L. 91, 104–05 (2000).

¹⁴⁶ See generally Robinson & Nohle, *supra* note 14.

¹⁴⁷ OFFICE OF GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE, DEPARTMENT OF DEFENSE LAW OF WAR MANUAL § 5.12.1.3 (2015) [hereinafter WAR MANUAL].

¹⁴⁸ *Id.* ¶ 5.12.1.3; DEPARTMENT OF THE ARMY, COUNTERINSURGENCY, 7–36 (2006).

atmosphere.”¹⁴⁹ Further, targets well-known for causing reverberating effects often appear on special considerations and restrictions.

In addition, history shows that some states have considered environmental reverberations before. For example, in the first Gulf War the Coalition considered the risk from contamination to surrounding areas before attacking nuclear, biological, and chemical weapons facilities. Consequently, the United States took positive steps to mitigate the likelihood of these environmental reverberations. It limited contamination time by exposing anthrax spores released from the facilities through destroying them with sunlight and heat.¹⁵⁰

However, the extent to which militaries incorporate environmental reverberations is still unknown. Indeed, parties may incorporate reverberation effects for political factors rather than from a perceived legal obligation. This appears in the case of the United States, which took such actions under a belief it was legally required but rather politically because they were not bound by the restrictions of AP I.¹⁵¹

Similar to the case for ICBL and landmines, increased attention and advocacy may increase political pressure on states to minimize their reverberations. The ICRC and a collation of humanitarian groups¹⁵² are now framing elements of the reverberations debate, namely the use of explosive weapons in populated areas, as a public health crisis. This moves discussion of them outside the usual IHL dichotomy of military necessity and proportionality.¹⁵³ In the future, this may increase political pressure on states to minimize the reverberations they cause. Given the overlap between the issue of explosive weapons in populated areas and some environmental concerns, this narrative may also help politically constrain permissible environmental harm. Similarly, the growing appreciation for the natural environment will likely pressure conflict parties consider reverberations *de facto*.

The proportionality principle, and IHL more widely, balances humanitarian and military considerations. Several commentators have expressed concern that including reverberating effects in proportionality creates an imbalance in weighing these concerns, to the detriment of the military. Others have suggested that placing too much emphasis on avoiding collateral damage can be counter-intuitive to humanitarian motivations as it may expose troops to greater risks and prolong the conflict. Striking the right balance between these competing considerations is not easy. Arguably, it would appear that reverberating effects give too much weight to inclusion of humanitarian concerns. It is this author’s opinion

¹⁴⁹ UNITED STATES CHAIRMAN OF THE JOINT CHIEF OF STAFF, NO-STRIKE AND THE COLLATERAL DAMAGE ESTIMATION METHODOLOGY, app § D-A-33 [hereinafter JOINT CHIEF OF STAFF].

¹⁵⁰ Michael W Lewis, *The Law of Aerial Bombardment in the 1991 Gulf War*, 97 AMERICAN J. INT’L L. 481, 489 (2003).

¹⁵¹ *Id.*

¹⁵² See *About INEW*, INT’L NETWORK FOR EXPLOSIVE WEAPONS, www.inew.org.

¹⁵³ BRIAN RAPPERT, HOW TO LOOK GOOD IN WAR: JUSTIFYING AND CHALLENGING STATE VIOLENCE, 111–13, 119–20 (2012); Int’l L. Ass’n Study Group, *supra* note 102, at 352–53.

however that in the particular case of environmental reverberations these concerns are mitigated. The natural environment is considered inferior to military concerns and consequently, for most attacks, environmental concerns are easily outweighed by military advantage.

It is this author's opinion that pressure is reflected in current literature on reverberating effects. Academic discourse is lacking the input of military states. Consequently, the literature favors humanitarian interests and does not accurately reflect the IHL's application in battle. To date, most of the current literature on reverberating effects has been produced by academics and humanitarian organizations and interest groups rather than states and non-state actors who are engaged in warfare.¹⁵⁴ Consider, for example, one of the most commonly cited documents in this debate is the ICRC's paper, "Proportionality and precautions in attack: the reverberating effects of using explosives weapon in populated areas." The ICRC self-describes its mission as including working for the "understanding and dissemination of knowledge of international humanitarian law applicable in armed conflicts and to prepare any development thereof."¹⁵⁵ However, in the past the ICRC has been criticized for being biased toward humanitarian objectives.¹⁵⁶ Such criticisms may be equally apt for their paper on reverberating effects which appears to have a humanitarian agenda.

Situations on the battlefield and legal discussions about reverberating effects do not always align. Fenrick describes discussions on targeting as taking place within two different forums: one forum with the legal advisors of armed forces and one with outside commentators, such as academics and interests groups, who have varying degrees of familiarity with IHL and with military operations.¹⁵⁷ He finds that a consequence of these two forums is that two separate bodies of law are created. The first is a confidential body of law which is used by militaries and therefore has real world impact. The second only exists in discourse and is "unduly tainted by both idealism and ignorance."¹⁵⁸ Ultimately, it is militaries who operate under and are bound by IHL. Their input into the discourse and consideration of their side is imperative to the debate. Short of military manuals and guidelines and some representation in expert meetings,¹⁵⁹ there has been limited military input in this area.

Indeed, the input of militaries who will carry out actions with reverberating effects is vital to ensure the discussions accurately reflect this law, in this case, those states who are launching military attacks. As Boothby emphasizes, "while all

¹⁵⁴ Wille & Borrie, *supra* note 18, at 4.

¹⁵⁵ Statutes of the International Committee of the Red Cross art. 4 §1(g) (2018).

¹⁵⁶ See Michael N Schmitt, *Military Necessity and Humanity in International Humanitarian Law: Preserving the Delicate Balance* 50 VA J INT'L L 795, 829–35 (2010).

¹⁵⁷ William J Fenrick, *Applying IHL Targeting Rules to Practical Situations: Proportionality and Military Objectives*, 27 Windsor Y.B. Access Just 271, 272 (2009).

¹⁵⁸ *Id.* at 273.

¹⁵⁹ *Explosive Weapons in Populated Areas – Humanitarian, Legal, Technical and Military Aspects*, INT'L COMM. RED CROSS (2015), <https://www.icrc.org/en/document/explosive-weapons-populated-areas-humanitarian-legal-technical-and-military-aspects>.

states are equal before the law, they are unequal in terms of their impact on events at both the strategic and tactical levels.”¹⁶⁰ For some states, including reverberations in their calculations may be easy: military power and prowess is not a defining characteristic of the state, or the state is not engaged in warfare. By contrast, the input of states whose behavior will be specially affected by the inclusion of reverberations, such as the United States, are crucial. Their opinions and behaviors are weighed more heavily in considering whether there is sufficient state practice to create customary law.¹⁶¹

However, militaries are largely secretive about their proportionality calculations. The effect is a widening of the “two forums.” States were reluctant to share their battlefield practice on proportionality with both the ICRC Study on Customary law and Fellmeth’s study on the status of proportionality under customary law.¹⁶² Given this secrecy, at expert meetings on reverberating effects calls for further information from states on how they view and interpret the proportionality principle have been made.¹⁶³ Without knowing what militaries do in the “fog of war,” it is hard to definitively ascertain the extent to which states do or do not consider reverberating effects.

In considering military interests, some commentators have expressed concern that incorporating reverberating effects into the proportionality calculations will create an “inherent and inequitable imbalance” in the favor of humanitarian interests.¹⁶⁴ They point to the explicit treaty limitation that military advantage be “concrete and direct” meaning only “substantial and relatively close” military interests can be included.¹⁶⁵ This excludes “advantages which are hardly perceptible and which would only appear in the long term.”¹⁶⁶ They contend the collateral damage element of proportionality elements would therefore have a wider scope.

In contrast, advocates have argued that including reverberating effects is necessary to achieve a genuine balance.¹⁶⁷ Military advantage is interpreted

¹⁶⁰ WILLIAM H BOOTHBY, *WEAPONS AND THE LAW OF ARMED CONFLICT*, 380 – 381 (Oxford University Press, Oxford, 2012).

¹⁶¹ *North Sea Continental Shelf Cases* (Germany v Denmark.; Germany v Netherlands), Judgements, 1969 ICJ Rep 3, ¶ 73 (Feb. 20).

¹⁶² A. Fellmeth, *The Proportionality Principle in Operation: Methodological Limitations of Empirical Research and the Need for Transparency*, 45 ISRAEL L. REV. 125, 147 (2012).

¹⁶³ *Explosive Weapons in Populated Areas – Humanitarian, Legal, Technical and Military Aspects*, *supra* note 157, at 22.

¹⁶⁴ Geoffrey S Corn, *The Unintended Consequences of New Restrictions on Fires in Urban Areas*, in *COMPLEX BATTLESPACES: THE LAW OF ARMED CONFLICT AND THE DYNAMICS OF MODERN* (Winston S Williams & Christopher M Ford eds., Oxford University Press, 2018).

¹⁶⁵ *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, *supra* note 20 ¶ 2209.

¹⁶⁶ *Id.*

¹⁶⁷ Rebecca J. Barber, *The Proportionality Equation: Balancing Military Objectives with Civilian Lives in the Armed Conflict in Afghanistan*, 15 J. CONFLICT & SECURITY L. 467, 481 (2010).

holistically, allowing the campaign as a whole to be assessed. While API does not specify this, the adjective “overall” is included in the ICRC customary law study,¹⁶⁸ in a series of state reservations attached to API¹⁶⁹ and is an explicit requirement for individual criminal liability under the Rome Statute.¹⁷⁰ Considerations of military advantage therefore have a larger temporal and geographic scope than permissible collateral effects.

In addition, including reverberating effects may unduly restrict targeting important military objects. Targets well-known for causing reverberating effects, such as electrical infrastructure, are also important military objects. In the past, electricity has been a primary target.¹⁷¹ Similarly despite being a known cause of extensive environmental harm, oil infrastructure remains a crucial target in warfare. Indeed, in the creation of article 56 of AP I, works and installations containing dangerous forces, some representatives at discussions specifically requested the inclusion of oil rigs, petroleum storage facilities, and oil refineries among others.¹⁷² This was not accepted however, and it was agreed that if these installations were to be given special protection this should be done in a different article. To date, there are no IHL rules specific to oil targets. Rather, oil infrastructure remains a critical target in warfare. For example, oil refineries, fields and other related infrastructure were critical targets in the United States’ conflict with ISIS.¹⁷³

Further, there are concerns that a restrictive proportionality application may be counter to humanitarian motives. As Nolte acknowledges with the proportionality principle there is a “search for the ideal, a drive toward sophistication. The question is how far this drive or sophistication is plausible without becoming counter-productive.”¹⁷⁴

Restrictive IHL laws may require that lesser force is used, exposing troops to greater risk.¹⁷⁵ In addition, rigid laws may force militaries to adopt predictable

¹⁶⁸ ICRC customary law study, above n 69, rule 14.

¹⁶⁹ For example, United Kingdom’s declaration para (i), in respect of API states: “the military advantage anticipated from an attack is intended to refer to the advantage anticipated from the attack considered as a whole and not only from isolated or particular parts of the attack.”

¹⁷⁰ Rome Statute, *supra* note 37, art. 8(2)(b)(iv).

¹⁷¹ Crawford, *supra* note 2, at 104.

¹⁷² *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, *supra* note 20, ¶ 2149, n. 10.

¹⁷³ See, e.g., Michael R. Gordon & Eric Schmitt, *US Steps Up Its Attacks on ISIS-Controlled Oil Fields in Syria*, N.Y. TIMES (Nov. 12, 2015) <https://www.nytimes.com/2015/11/13/us/politics/us-steps-up-its-attacks-on-isis-controlled-oil-fields-in-syria.html>.

¹⁷⁴ Georg Nolte, *Thin or Thick? The Principle of Proportionality and International Humanitarian Law*, 4 L. & ETHICS HUM. RTS. 244, 249, (2010).

¹⁷⁵ Noam Neuman, *Applying the Rule of Proportionality: Force Protection and Cumulative Assessment in International Law and Morality*, 7 Y.B. INT’L HUMANITARIAN L. 79, 80–82, (2004).

patterns of behavior, at the militaries' detriment.¹⁷⁶ Neumann uses the case of Operation Defensive Shield to illustrate these. To eradicate Palestinian forces, the Israel defense force entered a refugee camp in Jenin. In the hope of decreasing collateral damage, the IDF took a minimal force approach and cleared the area in a house-by-house manner. The IDF consequently suffered heavy casualties and was ultimately forced to increase their use of force.¹⁷⁷ In particular, scholars express that environmental considerations should not detriment the military.¹⁷⁸

Restrictive IHL laws also make it difficult to achieve military objectives. This, in turn, may increase the probability of an unfavorable outcome and prolong the conflict.¹⁷⁹ Sassòli and Cameron disagree with this concern for prolonging conflicts. They argue it conflates *jus ad bellum* and *jus in bello* by "presuppose[ing] that those aiming at shortening the war fight for an aim legitimate under the UN Charter."¹⁸⁰ This author respectfully disagrees. This argument does not seek shorter conflicts on the basis that the use of force is wrong, but rather to lessen impact to forces and collateral damage to civilian and civilian objects. As discussed previously, warfare is inherently harmful to the natural environment. The destruction it causes is multifaceted and is not limited to just damage ascertained from military attacks. For example, the movement of thousands of military vehicles in Iraq contributed to significant environmental harm.¹⁸¹ Given this, the greatest environmental protection may in fact be achieved by applying the principles of war to achieve quick, decisive victory.¹⁸²

While these are valid concerns for incorporating reverberating effects in general, this paper finds they lessened for environmental reverberations specifically. Commentators have criticized proportionality calculations for being heterogeneous and subjectively applied.¹⁸³ This is because the principal balances different entities, namely military and humanitarian factors, against each other without a common system of valuation; a situation several scholars have likened to comparing apples and oranges.¹⁸⁴ Humanitarian and natural environmental considerations are largely value judgments, making the principle's calculations temporally, contextually, and culturally variable.¹⁸⁵

¹⁷⁶ Joseph G. Garrett III, *The Army and the Environment: Environmental Considerations During Army Operations*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT 46 (Int'l L. Stud., Richard J. Grunawalt, et al., eds., 1996).

¹⁷⁷ Neuman, *supra* note 173, at 80–82.

¹⁷⁸ Garrett, *supra* note 174, at 46.

¹⁷⁹ *Id.* at 46.

¹⁸⁰ Sassòli & Cameron, *supra* note 109, at 60.

¹⁸¹ U.N. Env't Programme, Iraq, *supra* note 65, at 22.

¹⁸² Garrett, *supra* note 174, at 46.

¹⁸³ GARY D. SOLIS, THE LAW OF ARMED CONFLICT: INTERNATIONAL HUMANITARIAN LAW IN WAR 273 (Cambridge University Press) (2010); Schmitt, *supra* note 26, at 84; Droege & Tougas, *supra* note 40, at 32.

¹⁸⁴ See, e.g. Roni Katzir *For Comments on the Application of Proportionality under the Law of Armed Conflict*, 51 VAND. J. TRANSNAT'L L 857, 858 (2018), Yoram Dinstein, *The Principle of Distinction and Cyber War in International Armed Conflicts*, 17 J. CONFLICT & SEC. L. 261, 271 (2012).

¹⁸⁵ Schmitt, *supra* note 26, at 85–88; Reynolds, *supra* note 95, at 80.

These criticisms are particularly apt for environmental considerations. Valuations of the natural environment arguably vary more than civilian death and injuries. For example, the natural environment experiences increased recognition after sensationalized environment events and gradually achieved greater appreciation with the passage of time.¹⁸⁶ Further, a conflict party's concern for the environment will be dependent on the development pressures they face.¹⁸⁷ The subjectivity of proportionality calculations opens the principle to substantial politicization and manipulation to the military's favor.¹⁸⁸ The natural environment is regarded as inferior to military needs. Provided there is some non-negligible military advantage, most environmental concerns can often be dismissed.¹⁸⁹ As Arkin contends "if a credible scenario for reverberating natural environmental destruction on a global scale could be postulated, then likely the conduct of warfare would take precedence over the potential widespread harm."¹⁹⁰ Further, there is arguably less political incentive to enforce natural environmental violations than there is for humanitarian incidents. Conflict parties are often aware of their own natural environmental impact and are hesitant to draw international community's attention to this.¹⁹¹ Long-term reverberating effects have less political incentive to be incorporated as they may not arise until after scrutiny of the conflict has passed.

B. Workability

This section highlights the significant complexities including reverberating effects into proportionality calculations creates. Critics have rightly questioned the workability of this restriction. It is imperative that commanders are able to understand and consequently comply with IHL, even during the stresses of war. For these reasons, the boundaries of the law need to be clear. Arguably, even more so for individual criminal liability. The rule of law requires that laws be clear so that individuals are able to understand the legal boundaries of their conduct.¹⁹²

Increased complexity decreases the calculability of the proportionality principle.¹⁹³ Unfortunately, the principle is already regarded as highly uncertain and complex.¹⁹⁴ Introducing more considerations into its calculations may further

¹⁸⁶ Schmitt, *supra* note 26, at 140.

¹⁸⁷ *Id.*

¹⁸⁸ Sassòli & Cameron, *supra* note 109, at 64–65; Ben Clarke, *Proportionality in Armed Conflicts: A Principle in Need of Clarification* 3 J. INT'L HUMANITARIAN LEGAL STUD. 73, 82 (2012).

¹⁸⁹ *War Torn*, *supra* note 34, at 126; Schmitt, *supra* note 26, at 93; *see also NATO Bombing Report*, *supra* note 9, ¶ 22.

¹⁹⁰ William M Arkin, *The Environmental Threat of Military Operations*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT 117 (Int'l L. Stud., Richard J. Grunawalt, et al., eds., 1996).

¹⁹¹ *Id.* at 117, 119.

¹⁹² BERNHARD SCHLINK, SELF'S MURDER (Peter Constantine trans., Vintage Books, 2009); *see also* Nolte, *supra* note 173, at 248.

¹⁹³ Nolte, *supra* note 172, at 248.

¹⁹⁴ *NATO Bombing Report*, *supra* note 9, at [48].

reduce the principle's calculability and make it unworkable for military commanders.¹⁹⁵ This, in turn, increases the likelihood that reasonable military commanders may come to varying conclusions, reducing equality in the principle's application.¹⁹⁶ Horizontal legal systems, such as the international legal system, rely on visible application of the law to ensure compliance. There needs to clearly be a permissible and impermissible behavior so that the international community may obviously identify where breaches have occurred.¹⁹⁷ Identifying IHL violations can already be challenging, especially given the chaotic nature of warfare and the potential for political manipulation of facts. Greater complexity in proportionality calculations will arguably only enhance such challenges.

The core of this concern lies in the ambiguity of the word "expected." The law is largely silent regarding its application. Commentary to the AP I merely provides that the "interpretation must above all be a question of common sense and good faith for military commanders."¹⁹⁸ In light of reverberating effects, how should this be applied?

Scholars have suggested various theories on what this limitation means in practice. For example, the ICRC equates "expected" to "foreseeable" effects.¹⁹⁹ The requirement that collateral damage be "foreseeable" to be considered in proportionality calculations is also used in some commentary²⁰⁰ and in military manuals.²⁰¹ However, this is not the only threshold used. Academics have suggested numerous thresholds. For example, some have argued that an effect is expected where it would not have happened "but for" the attack occurring.²⁰² Others have suggested the threshold is where an effect's occurrence is believed to be "more likely than not"²⁰³ or "probable."²⁰⁴ Others have described "expected" in the negative, excluding effects which are theoretical, remote, feared, conceivable, not likely, speculative, or a mere possibility.²⁰⁵ Dinstein suggests it does not

¹⁹⁵ Nolte, *supra* note 172, at 248.

¹⁹⁶ SCHLINK, *supra* note 190; *see also* Nolte, *supra* note 172, at 248.

¹⁹⁷ Nolte, *supra* note 172, at 251.

¹⁹⁸ AP I, *supra* note 6, ¶ 2208.

¹⁹⁹ ICRC Q&A, *supra* note 10, at 104; Robinson & Nohle, *supra* note 14, at 121.

²⁰⁰ *See, e.g.* Cordula Droegge, *Get Off My Cloud: Cyber Warfare, International Humanitarian Law and the Protection of Civilians*, 94 INT'L. REV. RED CROSS 533, 573 (2012).

²⁰¹ *E.g.*, WAR MANUAL, *supra* note 145, at 348, n. 158.

²⁰² *See* Michael N. Schmitt et al., *Computers and War: The Legal Battlespace*, 9 (June 2004) (working paper) (on file with Harvard Univ. Program on Humanitarian Policy & Conflict Research); *see also* M ROSCINI, CYBER OPERATIONS AND THE CONDUCT OF HOSTILITIES, 221 (Oxford, Oxford University Press, 2014).

²⁰³ *See* William H. Boothby, *Cluster Bombs: Is There a Case for New Law?*, 28, n. 52 (Occasional Paper Series, Program on Humanitarian Policy and Conflict Research, Harvard University, 2005).

²⁰⁴ *Id.* at 28.

²⁰⁵ *See, e.g.*, Jack Beard, *The Principle of Proportionality in the Era of High Technology*, in COMPLEX BATTLESPACES: THE LAW OF ARMED CONFLICT AND THE DYNAMICS OF MODERN 279 (Winston S Williams & Christopher M Ford eds., Oxford, Oxford University Press, 2018); Henderson & Reece, *supra* note 16, at 852–53.

include “[l]ong-range costs looming a year or two after a military clash.”²⁰⁶ The *travaux préparatoires* to AP I reveal that the committee did consider inserting the words “which risks causing” incidental harm instead of expected.²⁰⁷ Jensen argues this is more restrictive than what “expected” is thought to mean. Had the words “which risks causing” been accepted, the standard would be closer to what is “likely” or even what is “possible.”²⁰⁸

The scope of the word “expected” is vital for environmental reverberations. The complex interconnectedness of the environment makes forecasting environmental damage less accurate than damage to things like infrastructure.²⁰⁹ Some reverberations will be impossible to predict.²¹⁰ Others will be foreseeable but lack scientific certainty. In such cases the hazard is therefore known but it is impossible to assign probabilities to its realization.²¹¹ As Schmitt emphasizes, “man is only beginning to unravel [the] complexity of the environment.”²¹² Environmental harm can be enhanced or reduced based on the natural environment’s ability to adapt. However, it is often unclear how exactly the environment will react to such events such as pollution and contamination.

The burning of the Kuwait oil wells during the 1991 Gulf War is a pertinent example of this.²¹³ Prior to burning of the oil wells, many scientists and government agencies attempted to predict the environmental impact. These predictions yielded a wide variety of conclusions, and many reputable scientists expressed concern that environmental impacts would be catastrophic. In particular, some predicted that the atmospheric pollution would amount to a “petroleum winter effect.” For example, at a meeting in January 1991, Cox, a consultant in the Gulf region, proposed that the burning of 300 oil wells would prevent the summer monsoon rainfall in India, adversely impacting crop productivity and starving several hundred million people worldwide. In total, the Kuwaiti Oil Company found that 613 oil wells were burned, 76 were gushing and 99 were otherwise damaged. While the burning of the oil wells undoubtedly had a substantial impact on the natural environment, fortunately some fears, including the “petroleum winter effect” did not eventuate.²¹⁴

In IEL, the precautionary principle was designed to mitigate issues of environmental uncertainty. It provides that uncertainty about future natural environmental damage does not allow parties to disregard the natural environment. Rather, sufficient risk of harm is enough to trigger measures to exclude the

²⁰⁶ Dinstein, *supra* note 140, at 92.

²⁰⁷ See Jensen, *supra* note 17, at 1180.

²⁰⁸ *Id.*

²⁰⁹ Cohan, *supra* note 45, at 495.

²¹⁰ THE ENVIRONMENTAL CONSEQUENCES OF WAR: LEGAL, ECONOMIC, AND SCIENTIFIC PERSPECTIVES, 299 (Jay E. Austin & Carl E. Bruch eds., 2000).

²¹¹ Joakim Zander, THE APPLICATION OF THE PRECAUTIONARY PRINCIPLE IN PRACTICE: COMPARATIVE DIMENSIONS, 14 (2010).

²¹² Schmitt, *supra* note 26, at 92.

²¹³ See, e.g. THE ENVIRONMENTAL CONSEQUENCES OF WAR: LEGAL, ECONOMIC, AND SCIENTIFIC PERSPECTIVES, *supra* note 208, at 312–14.

²¹⁴ See THE GULF WAR AFTERMATH: AN ENVIRONMENTAL TRAGEDY (Muhammad Sadiq & John C McCain eds., 2012) for a more complete description of the burning of the Kuwaiti oil wells.

reduction of that risk, even where damage cannot be forecast with certainty.²¹⁵ Both Desgnañes argue the precautionary principle is relevant in IHL.²¹⁶ Further the ICRC contend it is a customary rule stating “[l]ack of scientific certainty as to the effects on the natural environment of certain military operations does not absolve a party to the conflict from taking such precautions.”²¹⁷

Therefore, what may initially appear to be a preoccupation with semantics does in fact have real world effects for the scope of reverberating effects. The law does not currently provide commanders with sufficient guidance on how they should apply the expectation requirement for reverberating effects. At what level of probability does something become expected? Where does a commander draw the line for environmental reverberations being unexpected or scientifically uncertain? Arguably, the more factors, possibilities, and uncertainties that are introduced into the proportionality principle, the more difficult it will be for commanders to apply. Already some have argued the proportionality principle is vague and difficult to implement,²¹⁸ especially in the ‘fog of war.’²¹⁹ To include reverberating effects, greater clarity is needed.

Consider, for example, the quantification of reverberating effects in proportionality calculations. One viewpoint is that reverberations should be weighted according to its probability of occurring.²²⁰ This would mean that the less likely the effect is, the less it is weighed against military advantage. However, this complicates the process for commanders significantly, especially when they have to consider other uncertainties, such as weapon reliability.²²¹ Further, how is this requirement to be reconciled with the precautionary principle?

The alternative viewpoint is that all expected effects are calculated equally: the attacker either reasonably expects the harm or it is merely speculative.²²² Again, what amounts to “expected” is key. If a wide interpretation is adopted, military activities may be restrained due to fears that will never eventuate. As already discussed, too onerous restrictions on military activities may be counter intuitive. Ultimately, while militaries can assess the means and methods they use and the circumstances of their attacks, militaries do not have the capacity to look into the future.

Uncertainty is also an issue for reverberating effects as, by definition, they involve an intermediate event or mechanisms. Inevitably, the further down the line

²¹⁵ James Cameron & Juli Abouchar, *The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Natural Environment*, 14 B.C. Int’l & Comp. L. Rev. 1, 3 (1991); see, e.g., *Rio Declaration on Environment and Development*, supra note 41, princ. 15 for an example.

²¹⁶ Desgnañé, supra note 75, at 125.

²¹⁷ ICRC customary law study, supra note 69, rule 44.

²¹⁸ Gross et al., supra note 91, at 104.

²¹⁹ ROUTLEDGE HANDBOOK OF AIR POWER (John Andreas Olsen ed., 2018).

²²⁰ TALLINN MANUAL, supra note 11, at 135.

²²¹ Garrett, supra note 174, at 48; see also JOINT CHIEF OF STAFF, supra note 147, at D-2, 2(b) for an example.

²²² TALLINN MANUAL, supra note 11, at 135; Gross et al., supra note 91, at 87.

the chain of causation, the more room there is for other intervening factors.²²³ The law is currently uncertain regarding the boundaries of causation and expectation.

Consider for example the hypothetical put forward by Henderson and Reece concerning likely collateral damage to water infrastructure.²²⁴ They contend the commander is obliged to consider all expected damage. If the resulting damage is likely to indirectly cause civilians to die of thirst, this, they contend, must be incorporated into proportionality calculations. However, what then if the commander receives information that bottled water can be provided to civilians whilst damage is repaired. Further, what if the bottled water cannot be distributed to a small part of the population? Are their deaths now inevitable?

Arguably, their deaths are not inevitable, as a wide variety of events could occur before the civilians die of thirst. For example, they could relocate, humanitarian aid could be provided, the armed conflict may end, or rainwater may be harvested. It cannot be concluded that those civilians dying of thirst is an inevitable result or even confidently predictable.²²⁵ Viewed in this way, the commander therefore could not have “expected” their deaths.

In addition, the result of civilians dying could be too remote to be considered as a reverberating effect.²²⁶ Between the attack and the result there is the potential for a wide variety of events to occur; some that may mitigate the harm, others that may remove it. Where there are too many possibilities involved, arguably the attack cannot be said to “cause” the civilian’s death. Rather, it was a factor in its occurrence.

Again, the current law does not provide any guidance on how conflict parties should interpret such situations. Incorporating reverberating effects into proportionality calculation introduces new questions as to what the appropriate level of probability is and how far down the chain of causation commanders would need to consider. It is imperative that commanders are aware of the boundaries of their actions. To include reverberating effects as a workable proposition, substantial clarity is needed.

C. Responsibility for Harm

In addition, it is this author’s opinion that due to the presence of an intervening event or mechanism the attacking party does not have sole responsibility for causing reverberating effects. Rather, the actions of the victim party can significantly decrease or enhance the impact of reverberating effects. IHL prescribes obligations for both conflict parties to take care to protect civilians and civilian objects. Incorporating reverberating effects in proportionality calculations

²²³ Kenneth R. Rizer, *Bombing Dual-Use Targets: Legal, Ethical, and Doctrinal Perspectives*, AIR & SPACE POWER J., at 8 (May 1, 2001), <http://www.airpower.maxwell.af.mil/airchronicles/cc/Rizer.html>.

²²⁴ See Henderson & Reece, *supra* note 16, at 853 for a complete account of the hypothetical.

²²⁵ *Id.*

²²⁶ *Id.* at 853–54.

suggests that the attacking party was the sole cause of the harm, despite there being nuances in responsibility.

Compounding factors and underlying vulnerabilities of the victim state impact the extent of harm caused by reverberations. Several scholars have used the term “resilience” to describe a community’s ability to repair damage or put alternative solutions in place to reduce the harm caused by reverberating effects.²²⁷ Resilient communities therefore experience less severe reverberating effects. Zeitoun and Talhami, in their discussion on reverberating effects and infrastructure, measure the baseline service resilience of communities in terms of redundancies and the level of emergency preparedness and the community’s ability to respond. They describe, for example, that “[a] drinking water system that has diversified water sources ... is resilient because each replication subdivides the service, and so limits the physical extent of, and number of people affected by, any damage.”²²⁸

Resilience was found to be a factor in enhancing and decreasing the impact of reverberating effects. Consequently, the impact of reverberating effects can be caused by *both* the attacking and victim parties’ actions. For example, following the 2006 Lebanon War, the Lebanon Government reported that 45 mains and 258 secondary water distributions systems and 38 main and 120 secondary sewage disposal systems had been destroyed or damaged. Water quality and the threat it posed for human health was a major concern following the war. However, the UNEP post-conflict assessment indicates that the poor water quality was a mixed result of the conflict *and* Lebanon’s poor maintenance of the infrastructure.²²⁹

For environmental reverberations, resilience includes the sensitivity of natural environment in the area.²³⁰ Environmentally sensitive areas tend to suffer more drastic consequences from reverberations and recover at a slower rate.²³¹ For such reasons, conflict parties are often encouraged not to attack such areas. For example, the San Remo Manual encourages its military not to engage in marine areas of rare or fragile ecosystems and threatened marine life.²³²

Underlying conditions in the victim state may mean that environmental reverberations may not even be solely attributable to the attacking party. For example, there may be pre-existing pollution, as was the case with the NATO bombings. The Balkans Task Force found that most of the discernable natural environmental contamination could not unambiguously attributed to the NATO bombings: “part of the contamination identified at some sites clearly pre-dates the Kosovo conflict, and there is evidence of long-term deficiencies in the treatment and storage of hazardous waste.”²³³ The ICTY was therefore unable to make a finding of disproportionality or impermissible natural environmental harm, among other reasons. Similarly, in the case of El Jyieh the UNEP was unable to ascertain

²²⁷ Wille & Borrie, *supra* note 18, at 11; Zeitoun & Talhami, *supra* note 17, at 63–64.

²²⁸ Zeitoun & Talhami, *supra* note 17, at 64.

²²⁹ UNEP, Lebanon, *supra* note 57, at 118–19.

²³⁰ Michael J Lawrence et al, *The Effects of Modern War and Military Activities on Biodiversity and the Environment*, 23 ENV’T REV 443, 443 (2015).

²³¹ Halpern, *supra* note 44, at 123.

²³² Schmitt, *supra* note 12.

²³³ Report on NATO Bombing, *supra* note 32, ¶ 17.

whether soil contamination surrounding the power plant was a consequence of the impact of the fire or whether it was a consequence of poor filtering of exhaust gas during normal plant operations.²³⁴ Further, “[d]ue to the lack of groundwater baseline data for the southern suburbs of Beirut, it was not possible to conclude that the contamination was solely conflict related rather than the legacy of pre-existing pollution.”²³⁵ This poses a threat for environmental reverberations. Given that the pollution was not the sole responsibility of the attacking party, is it fair to attribute further reverberations, such as the impact on people or aquatic life, to them?

In some domestic jurisdictions, criminal and tort law have answered similar questions of harm and responsibility by requiring offenders to accept all harm caused to the victim regardless of their peculiar fragilities. “It is no answer to a claim for a fractured skull that the owner had an unusually fragile one.”²³⁶ However, the application of this principle during warfare is questionable.

Crucially, IHL explicitly provides that both conflicting parties have obligations to protect civilian and civilian objects during warfare.²³⁷ Part of victim party’s responsibilities include clearly distinguishing between civilian and civilian objects and military objects.²³⁸ As discussed, much of the recent advocacy for reverberating effects has stemmed from the increased use of reverberating weapons in populated areas. In such areas, civilians, civilian objects, and military objects are intermingled and difficult to discern. As a result, the collateral damage tends to be more profound than if military objects were rurally located. The narrative surrounding reverberating effects has solely focused on the obligations of the attacking party. However, the victim party evidently shares responsibility too. Indeed, in some conflict’s militaries, particularly those of non-state actors, have purposely intermingled civilian and military objects against their IHL obligations with the presumed intention of disincentivizing the use of force.²³⁹ The use of human shields is prohibited in IHL. Using human shields is “utilizing the presence of a civilian or other protected person to render certain points, areas or military forces immune from military operations.”²⁴⁰ In the final report to Congress on the 1991 First Gulf War, the United States emphasized the dual responsibility of conflict parties. It argued that the actions of the Iraq in using civilian infrastructure for military purposes and not moving civilians from targets lead to increased collateral damage.²⁴¹ It characterized its air strike as “the most discriminate air campaign in history.”²⁴²

234 UNEP, Lebanon, *supra* note 57, at 46.

235 *Id.* at 120.

236 *Owens v. Liverpool Corporation*, [1939] 1 K.B. 394 (C.A. Civ.) (Eng.).

237 *See, e.g.*, AP I, *supra* note 6; ICRC customary law study, rule 1 and 7.

238 Geneva Convention Relative to the Protection of Civilian Persons in Time of War, Aug. 12, 1949, 6 U.S.T. 3516, 75 U.N.T.S. 287 (opened for signature, 12 August 1949, entered into force, 20 October 1950), art 28; AP I, *supra* note 6, art. 51 ¶ 7; ICRC customary law study, *supra* note 69, rule 7.

239 ICRC customary law study, rule 97.

240 Rome Statute, *supra* note 37, art. 8(2)(b)(xxiii).

241 Final report to Congress, *supra* note 4, at 696–703.

242 *Id.* at 98.

As a civilian object, conflict parties are similarly positively obliged to separate the natural environment from military objectives. Hulme also contends that the use of the word “warfare” in article 55 suggests that both parties engaged in conflict are obliged to care in about protecting the environment.²⁴³ Separating the natural environment from military objectives is arguably more difficult than removing civilians. However, this does not mean that a victim state is completely neutral in responsibility. Concerningly, in recent conflicts combatants and military objects have been situated in environmentally sensitive and protected areas.

In addition, it has been suggested that the obligation of the victim side to protect civilians and civilian objects is even the predominant responsibility.²⁴⁴ Indeed, it is contended that the party controlling civilians and civilian objects has the greatest opportunity to minimize risk.²⁴⁵ Waxman justifies this stating:

First, the defending force often has substantial control (whereas the attacker has none) over where military forces and equipment are placed in relation to the civilian population. Second, the defending power often has better information than the attacker about where civilian persons and property actually are, and is therefore better positioned to avoid knowingly leaving them in harm’s way. And third, the defender’s actions - including its proper efforts to protect itself by resisting attack – may contribute to the danger facing noncombatants. The defender’s choice of strategy, too, will significantly determine the extent to which civilians are vulnerable to possible attack.²⁴⁶

Similar arguments were seen in the CCW discussions concerning ERWs. Factors that invariably impact the harm sustained, such as when civilians are permitted to return to an area, and how ERWs will be removed, are decisions for the victim state.²⁴⁷

The ICTY in the *NATO Bombing Case* emphasized that, despite the obligations to remove civilians from the vicinity of military objectives, “civilians present within or near military objectives must, however, be taken into account in the proportionality equation even if a party to the conflict has failed to exercise its obligation to remove them.”²⁴⁸ The author does not disagree with this statement. Rather, she expresses concern that incorporating reverberating effects in proportionality calculations does attribute collateral damage to the attacking state that they did not solely cause nor solely have control of. This undermines the dual

²⁴³ Hulme, *supra* note 39, at 680.

²⁴⁴ WAR MANUAL, *supra* note 145, at 186.

²⁴⁵ *Id.*

²⁴⁶ MATTHEW C WAXMAN, INTERNATIONAL LAW AND THE POLITICS OF URBAN AIR OPERATIONS 1 (RAND, 2000); Schmitt, *supra* note 153, at 828.

²⁴⁷ See United States, CCW Group of Governmental Experts Working Group on Explosive Remnants of War, Responses to Document CCW/GGEIX/WG.1/WP2, Entitled IHL and ERW, Dated 8 March 2005, 7, U.N. Doc. CCW/GGE/XI/WG.1/WP.5 (2005).

²⁴⁸ NATO Bombing Report, *supra* note 9, ¶ 51.

obligations of IHL and may further encourage victim parties to intermingle military and civilian objects, including the natural environment, to minimize force used against them.

This discussion is further complicated by the relationship between resilience and protracted conflicts. Often in ongoing conflicts a party's overall capacity to protect, repair, and rehabilitate decreases. Indirect and direct impact from attacks can cumulatively create "vicious cycles" by decreasing resources, damaging infrastructure, decreasing access to materials and aid, and lessening human resources.²⁴⁹ This reduces the victim state's resilience to attacks. For example, accessible water resources may become scarcer and/or those remaining contaminated and over-pumped. This may be particularly so where the population increases due to displaced persons.²⁵⁰

D. Information and Expertise

Finally, due to the perspective nature of proportionality calculations, accurate predictions regarding the likely collateral damage are highly dependent on the quantity and quality of information available to the decision maker. This section argues that level of information and expertise required to adequately predict reverberating effects is too onerous for conflict parties. Some military manuals provide that decisions should be based on information available at the time of the attack,²⁵¹ while others refer to information reasonably available.²⁵² Several military manuals provide that commanders are under a higher obligation, namely to obtain the "best possible intelligence."²⁵³

Being able to expect reverberating effects requires significant information on to the circumstances of the attack. For example, Robinson and Nohle contend that collateral damage to an electricity network may have a reasonably foreseeable impact on a hospital. In brackets they note, "particularly if backup generators are not available."²⁵⁴ Whether the hospital has access to backup generators is crucial in understanding whether the threat posed by reverberating effects will be mitigated or potentially even removed. Factors that may have a considerable impact on the resulting reverberations may be difficult for the attacking party to sustain. Militaries cannot be expected to know everything, especially considering that and they will be limited to resource and time sensitivities.²⁵⁵ The law is further unclear whether as to how militaries are to approach reverberating effects in light of limited

²⁴⁹ Zeitoun & Talhami, *supra* note 17, at 63–64.

²⁵⁰ *Id.* at 15.

²⁵¹ Robinson & Nohle, *supra* note 14, at 135.

²⁵² *Id.*

²⁵³ See e.g. MINISTRY OF DEFENSE, THE JOINT SERVICE MANUAL OF THE LAW OF ARMED CONFLICT § 5.20.4 (2004).

²⁵⁴ Robinson & Nohle, *supra* note 14, at 132.

²⁵⁵ *Explosive Weapons in Populated Areas – Humanitarian, Legal, Technical and Military Aspects*, *supra* note 156, at 6; Clarke, *supra* note 186, at 81–82; Joint Chief of Staff, *supra* note 148, at D-2, 2(e).

information. To turn back to Henderson and Reece's example, if a commander has no available information should they predict that humanitarian aid will be provided?

Information for collateral environment information is not always as available as comparably as information relating to typical collateral damage.²⁵⁶ Indeed, the international law commission has called on greater environmental sharing between parties.²⁵⁷ The situation is also more difficult for environmental reverberations as research into them is underdeveloped.²⁵⁸ Further, the unpredictability of ecological systems mitigates the applicability of previous conflicts studies.²⁵⁹

In addition to environmental information, there is need for expertise to adequately predict what it means for the potential take. As discussed, the reasonable military commander standard requires a certain degree of operational expertise, namely that of a military commander. However, commentators express concern that commanders may not be capable of ascertaining or competently analyzing reverberating effects.

Consequently, calls have been made for relevant experts, including engineers and public health experts, to be employed by militaries.²⁶⁰ Similarly, Schmitt questioned whether including environmental reverberations would in turn require environmental expertise.²⁶¹ In some militaries, a level of expertise for environmental impacts is already provided through engineers, medical officers, and intelligence officers.²⁶² For example, the United States Field Manual on Intelligence Support to Urban Operations includes references to engineer who assess potential collateral damage "caused by the release of dangerous forces, power grid and water source stability, and the viability of sewage networks."²⁶³ Similarly, the United States Joint Chief of Staff document states that potential environmental harm is reviewed by the National Center for Medical Intelligence for a Chemical Hazard Area Modeling Program (known as "CHAMP")²⁶⁴ and the Sensitive Target Approval and Review (known as "STAR"). Environmental reverberations however may require other specialists and more than one type of expertise. Some circumstances require specialists who have local knowledge. This

²⁵⁶ Schmitt, *supra* note 26, at 92.

²⁵⁷ See e.g. principle III-5 Special Rapporteur Annex I to ILC 68th sess A/CN.4/700 (2016).

²⁵⁸ Dathan, *supra* note 60, at 28.

²⁵⁹ THE ENVIRONMENTAL CONSEQUENCES OF WAR: LEGAL, ECONOMIC, AND SCIENTIFIC PERSPECTIVES, *supra* note 209, at 299.

²⁶⁰ Eric Boylan, Note, *Applying the Law of Proportionality to Cyber Conflict: Suggestions for Practitioners*, 50 VAND. J. TRANSNAT'L L. 217, 239-41 (2017); Droege, *supra* note 199, at 574; TALLINN MANUAL, *supra* note 11, at 166; Zeitoun & Talhami, *supra* note 17, at 69; Robinson & Nohle, *supra* note 14, at 136.

²⁶¹ Schmitt, *supra* note 26, at 92.

²⁶² Garrett, *supra* note 174, at 51.

²⁶³ Department of the Army *Field Manual on Intelligence Support to Urban Operations* (FM 2-91.4, 2008) at 2-91.4, 3 -2.

²⁶⁴ Joint Chief of Staff Manual, above n 148, at D-A-10, Appendix A to Enclosed D: The CDM Process, 2.(b)(6)(a), (b) and (c).

is arguably too onerous to expect of militaries, particularly in the context of war. Ultimately, militaries have finite finances, resources, and time.

V. CONCLUDING REMARKS

Reverberating effects pose a significant threat to the natural environment and people. This paper argues that conflict parties currently do not appear legally obliged to consider environmental reverberations in their proportionality calculations. Rather, conflict parties need only consider them when it appears the environmental harm may reach the threshold of “widespread, long-term and severe” or for political reasons. Further, this paper does not recommend that environmental reverberations be included in proportionality calculations. Primarily, including reverberations introduces considerable complexity to these calculations. Further, a restrictive approach towards a party may limit a military’s ability to fulfill its objectives and in turn have counterintuitive results. Moreover, including reverberating effects into proportionality calculations solely attributes responsibility to the attacking party, even where the victim state also contributes to the harm. In such situations it is difficult to contend the attacking state did in fact “cause” the event. Finally, to properly predict reverberating effects, attacking parties need substantial information and expertise, especially for environmental reverberations. This may be practically difficult due to time and resource constraints. Reverberating effects are a complex issue, especially in an environmental sense. Indeed, Schmitt lists many questions the law needs to answer for including environmental reverberations.²⁶⁵ Unfortunately, it seems that the law still remains unclear on many of these.

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Schmitt, *supra* note 26, at 92.

