INTRODUCTION

JAY E. AUSTIN AND CARL E. BRUCH

For centuries, military commanders have deliberately targeted the environment, seeking to obtain any possible advantage over their adversaries. In the Third Punic War, Roman legions salted the ground around Carthage to prevent the Carthaginians from recovering and challenging Rome; in the US Civil War, General Sherman cut a wide swath of destruction across the South in an attempt to break the morale of the Confederacy; in World War I, the British set afire Romanian oilfields to prevent the Central Powers from capturing them; in World War II, Germany and the Soviet Union engaged in "scorched earth" tactics; and in the Korean War, the United States bombed North Korean dams.[1]

The Vietnam War showcased the increasingly devastating environmental effects of modern military technology, with entire ecosystems targeted. The United States engaged in a massive defoliation campaign to preclude the growth of groundcover,[2] and even attempted to change

[1] See Adam Roberts, "Environmental Issues in International Armed Conflict: The Experience of the 1991 Gulf War," in Richard J. Grunawalt et al. (eds.), *Protection of the Environment during Armed Conflict* (Newport, R.I.: Naval War College, 1996), p. 225 (describing the destruction of Romanian oilfields by Colonel Norton Griffiths); Harry G. Summers, "Desolation and War: Necessity and Choice," paper delivered at the First International Conference on Addressing Environmental Consequences of War: Legal, Economic, and Scientific Perspectives, Washington, D.C. (June 1998) (manuscript on file with editors) (describing environmental impacts of Sherman's march to the sea, World War II, and the Korean War); see also Michael D. Diederich, Jr., " 'Law of War' and Ecology – A Proposal for a Workable Approach to Protecting the Environment through the Law of War," *Mil. L. Rev.* 136 (1992), 137 (discussing Persian commander Cyrus II diverting the Euphrates River during a siege of Babylon, Boers burning grasslands to deny forage to the British in the Second Anglo-Boer War, and Chinese dynamiting a dike to prevent Japanese troops from advancing in World War II).

[2] E.g., Arthur H. Westing, *Ecological Consequences of the Second Indochina War* (Stockholm: Almqvist & Wiksell Int'l, 1976), pp. 28, 47.

weather patterns via cloud seeding over North Vietnam to hamper enemy troop movements and provide protection for US bombing missions.[3] Since then, the public health implications of environmental warfare in Vietnam – primarily birth defects, diseases, and premature death associated with exposure to Agent Orange – have become apparent.[4] The scale, severity, and longevity of these environmental impacts sparked the first international legal provisions specifically prohibiting environmental warfare: the 1976 Environmental Modification Convention (ENMOD) and the 1977 Additional Protocol I to the 1949 Geneva Conventions (Protocol I). Notwithstanding international condemnation of such tactics, Central American internal conflicts of the 1980s saw further use of defoliation campaigns, albeit to a lesser degree than in the Vietnam War.[5]

The 1990–91 Gulf War may have seen the most concerted effort to destroy an enemy's environment, as Iraqi troops detonated more than 700 Kuwaiti oil wells, igniting over 600 of them. Smoke from the fires created black rain in Iran and Turkey, and possibly extended as far east as India.[6] Oil lakes created by damaged oil wells have seeped through the desert soils, contaminating the water table.[7] In an attempt to clog Kuwaiti desalinization plants and hinder an amphibious landing, Iraq also discharged an estimated 6 to 11 million barrels of crude oil directly into the Gulf, devastating

[3] E.g., Arthur H. Westing, *Weapons of Mass Destruction and the Environment* (London: Taylor & Francis, 1977), pp. 55–60; Seymour M. Hersh, "Rainmaking is Used as Weapon by US," *N.Y. Times* (July 3, 1972), A1; "Senator C. Pell Says He Believes US Military Forces Use Rain-Making to Cause Flooding and Death in Vietnam," *N.Y. Times* (June 27, 1972), A12.

[4] E.g., Arnold Schecter et al., "Agent Orange and the Vietnamese: The Persistence of Elevated Dioxin Levels in Human Tissues," *Am. J. Pub. Health* 85 (1995), 516; D. A. Savitz et al., "Vietnamese Infant and Childhood Mortality in Relation to the Vietnam War," *Am. J. Pub. Health* 83 (1993), 1134. But see Alastair Hay, "Defoliants: The Long-Term Health Implications," chapter 16 in this volume (questioning whether the public health data show these effects).

[5] E.g., *Guatemala: A Political Ecology*, EPOCA Green Paper No. 5 (1990), p. 13 (reporting the use of 2,4–D and 2,4,5–T, the herbicidal ingredients of Agent Orange, as well as paraquat in defoliation campaigns in regions of guerrilla activity); Bill Hall and Daniel Faber, *El Salvador: Ecology of Conflict*, EPOCA Green Paper No. 4 (1989), pp. 1, 7, 8–9 (describing scorched earth strategies, as well as the defoliation associated with heavy bombing and white phosphorus); Bill Weinberg, *War on the Land: Ecology and Politics in Central America* (1991), pp. 63–64 (detailing incendiary bombs, napalm, and white phosphorus used in El Salvador).

[6] Hunay Evliya, "Black Rain in Turkey: Possible Environmental Effects of the Gulf War," *Envtl. Sci. & Tech.* 26 (1992), 873; "Black Rain on Bushehr Province of Iran," *L.A. Times* (Jan. 24, 1991), A7.

[7] Thomas Canby, "After the Storm," *Nat'l Geographic* 180 (Aug. 1991), 2, 7; see also Samira A. S. Omar et al., "The Gulf War Impact on the Terrestrial Environment of Kuwait: An Overview," chapter 12 in this volume.

the marine environment.[8] The releases of oil also had tragic effects on migratory birds that were caught in oil lakes and slicks. The public health impacts from exposure to the oil smoke and particulates have started to manifest themselves in the form of respiratory ailments.[9]

While the Vietnam War was the first to isolate the environmental consequences of war as a separate legal issue, the 1990–91 Gulf War created such severe environmental devastation that the international community was compelled to create an institution to enforce legal norms. After the war, the UN Security Council declared Iraq liable for all damages arising as a result of its illegal invasion and occupation of Kuwait, explicitly including environmental damages and depletion of natural resources, and established the United Nations Compensation Commission to review claims and make compensation awards. While the UNCC's mandate is limited to the 1990–91 Gulf War, it is notable as the first international body charged with evaluating and compensating for wartime environmental damages, and its decisions will necessarily carry significant weight in future endeavors.

As in most conflicts, the environmental damage in the 1990–91 Gulf War was not unilateral. The region is now littered with as much as 300 tons of armor-piercing depleted uranium (DU) ammunition used by Coalition (largely US) forces.[10] The Coalition forces dropped a total of 88,500 tons of ordnance during the forty-three days of the Gulf War, much of which targeted environmental infrastructure, such as sewage treatment plants,[11] and some of which remained on the ground unexploded. No objective study of the ecological, health, or economic effects of these actions is available.[12]

More recently, Colombian rebels have detonated petroleum pipelines, spilling millions of barrels of crude oil into rivers, contaminating drinking and irrigation water, killing fish and other wildlife, contributing to

[8] E.g., "Millions of Gallons of Crude Oil Flow into Persian Gulf from Kuwaiti Tanks," *Int'l Env't Rep.* 14(2) (Jan. 30, 1991), 37; see also Mahmood Y. Abdulraheem, "War-Related Damage to the Marine Environment in the ROPME Sea Area," chapter 13 in this volume.

[9] E.g., K. T. Kelsey et al., "Genotoxicity to Human Cells Induced by Air Particulates Isolated during the Kuwait Oil Fires," *Envtl. Res.* 64 (1994), 8; Basem R. Saab and Salim M. Adib, "Acute Asthmatic Attacks in Bahrain in the Wake of the Gulf War: A Follow-up," *J. Envtl. Health* 58(9) (1996), 23.

[10] Saul Bloom et al. (eds.), *Hidden Casualties II: The Environmental, Health and Political Consequences of the Persian Gulf War* (1994), p. 135.

[11] *Ibid.*, pp. 146–48.

[12] For one reason, see John Horgan, "US Gags Discussion of War's Environmental Effects," *Sci. Am.* (May 1991), 24.

forest fires and oil pollution, sterilizing soil, and harming riverside communities.[13] The aquatic impacts extended beyond national borders to Venezuela, placing the Venezuelan government in the delicate position of trying to recover damages from the Colombian government for impacts to its rivers caused by Colombian rebels. Kurdish rebels in Turkey have adopted a similar tactic of detonating Turkish petroleum pipelines, although to a lesser degree.[14]

The 1999 Kosovo conflict raised further environmental issues. Serbian forces and militias poisoned wells and allegedly engaged in scorched earth tactics to spur Kosovar Albanians to leave their homes.[15] NATO's 78-day bombing campaign caused severe damage to certain areas, particularly around the oil refinery, petrochemical, and fertilizer plant complex at Pancevo and at the industrial facilities of Novi Sad.[16] Again, the issue of depleted uranium came to the fore, and targeting of civilian infrastructure such as sewage treatment facilities has reportedly caused environmental damage not only in Yugoslavia, but also downstream in Romania and Bulgaria.[17]

The Kosovo conflict also marked the broadest public participation to date in assessing and reporting on wartime environmental damage. During the conflict, nongovernmental organizations and concerned citizens monitored and documented the environmental effects of the bombing on Yugoslavia and neighboring countries, generating a steady stream of reports on the Internet and in the media.[18] Immediately following the cessation of hostilities, the United Nations Environment Program established an expert task force (including NGO representatives) to assess environmental damage, as it had done after the 1990–91 Gulf War. These experiences suggest an emerging role for the environmental NGO com-

[13] E.g., "Colombia Urges UN to Designate Bombing of Pipelines as Environment Treaty Violation," *Int'l Env't Rep.* 21 (1998), 175.

[14] "Turkey: Kurds Blow up Oil Pipeline," *N.Y. Times* (Mar. 24, 1999), A15.

[15] E.g., R. Jeffrey Smith, "Refugees Scavenge for Shelter in Scorched Earth of Kosovo," *Wash. Post* (Aug. 5, 1999), A14; R. Jeffrey Smith, "Poisoned Wells Plague Towns All Over Kosovo," *Wash. Post* (Dec. 9, 1998), A30 (citing an estimate of thousands of poisoned wells).

[16] E.g., Regional Environmental Center for Central and Eastern Europe, *Assessment of the Environmental Impact of Military Activities during the Yugoslavia Conflict: Preliminary Findings* (June 1999), available at http://www.rec.org/REC/Announcements/yugo/contents.html.

[17] *Ibid.*

[18] E.g., *ibid.*; "Hungary Finds Air Contaminated in Wake of NATO Strikes," ITAR-TASS (June 7, 1999).

munity: monitoring and publicizing the environmental consequences of war in order to assist ongoing efforts to hold militaries accountable for their wartime actions. They also suggest that wartime environmental damage will continue to be a legitimate area of inquiry and assistance, alongside concerns about human rights, refugee populations, and civilian infrastructure.

Ironically, war occasionally can benefit the environment. During the Nicaraguan civil war of the 1980s, timber felling ceased; conversion of forests to agricultural land slowed and stopped; animal trafficking largely halted; and fishing harvests fell as fishermen, fearing naval mines, stayed ashore, which allowed depleted stocks to recover.[19] Many of the remaining intact ecosystems in Central America continue to be threatened by conversion by agrarian peasants, except for those seeded with landmines during the civil wars. Similarly, perhaps the most biologically diverse area on the Korean Peninsula is the heavily mined Demilitarized Zone, a 4-km-wide no-man's land where there is no development or hunting.[20]

Of course, in all of these conflicts, the human toll has been enormous. Given the broader context of wartime calamity, emphasis on the environment may seem inappropriate or misguided. Yet even here, the primary concern is humanitarian and anthropocentric: at some point, incidental or intentional environmental harm can become so severe that it harms human health, especially that of innocent civilians. Inhalation of excessive smoke and airborne toxics can lead to respiratory ailments and cancers, ingestion of persistent toxics and radionuclides can cause both short- and long-term health impacts, and many of the substances mobilized during environmental warfare are mutagenic or teratogenic, affecting not just the present population but also future generations. Environmental damage also impairs the long-term ability of the civilian population to support itself, destabilizing society and sowing the seeds for further conflict. And

[19] Bernard Q. Nietschmann, "The Effects of War and Peace on Nicaragua's Environments," paper delivered at the First International Conference on Addressing Environmental Consequences of War: Legal, Economic, and Scientific Perspectives, Washington, D.C. (June 1998) (manuscript on file with editors); Pascal O. Girot and Bernard Q. Nietschmann, "The Río San Juan," *Nat'l Geographic Res. & Exploration* 8(1) (1992), 52, 58–59.

[20] Ke Chung Kim, "Preserving Biodiversity in Korea's Demilitarized Zone," *Sci.* 278 (1997), 242; see also William K. Stevens, "Unlikely Tool for Species Preservation: Warfare," *N.Y. Times* (Mar. 30, 1999), D1 (describing how American bison survived primarily in "buffer zones between warring tribes").

beyond these human concerns, enhanced public awareness of environmental issues over the past three decades and the increasing globalization of environmental issues has led some commentators to advocate wartime constraints on purely ecological, non-anthropocentric grounds.[21]

Perhaps the most candid response to critics who question the importance of addressing and legislating against wartime environmental damage is to acknowledge that it, like most of international humanitarian law, is an incrementalist enterprise. The history of the law of war has been one of a gradual narrowing of what the community of nations considers to be acceptable, indeed civilized, methods of combat. This is true whether one considers the laws restricting weapons, which have steadily progressed from banning gas and explosive bullets to condemning weapons of mass destruction to the recent focus on landmines, which are both a humanitarian and an environmental problem; or whether one considers the laws restricting wartime actions and targets, which have expanded to protect not only combatants, but also prisoners of war, the civilian population, property, and historical and cultural monuments. Now that the law of war recognizes not only humanitarian concerns, but also our material, cultural, and aesthetic legacy, it is a small leap to propose an "environmental law of war." To the extent that this effort derives from the law-of-war tradition, it may seem inadequate to skeptics who question the efficacy of any attempts to place restrictions on warfare, or who believe that such restrictions are only enforced against nations that, like Iraq, are thoroughly defeated in combat. Yet even the most ardent critics of the existing norms generally admit that gradualist reforms can exist side by side with more radical proposals – including those that seek to curtail the waging of war altogether.

This book draws upon papers presented at and research connected to the "First International Conference on Addressing Environmental Consequences of War: Legal, Economic, and Scientific Perspectives," which was co-sponsored by the Environmental Law Institute, the Smithsonian Institution, and the Kuwait Foundation for the Advancement of Sciences in June 1998 in Washington, D.C. Numerous other conferences, articles, and books have considered the legal regime for preventing or redressing

[21] See the discussion in Christopher D. Stone, "The Environment in Wartime: An Overview," chapter 1 in this volume.

wartime environmental damage, and similar efforts have attempted scientifically to assess and value environmental impacts of particular conflicts.[22] The Washington conference and this resulting volume are unique in bringing together lawyers, scientists, economists, military officers, and ethicists to consider how to address environmental consequences of war in a multidisciplinary manner. By considering the issue from a variety of perspectives, we have sought to improve communication among the different disciplines, and to ask what they need from each other, what are their current limitations, and what are the opportunities for collaborating to develop necessary methodologies in the future.

The book begins with basic cultural principles, examines the existing legal norms and institutions for preventing and redressing wartime environmental damage, considers the scientific and economic methodologies for assessing and valuing the damage within a legal framework, and then looks forward to a variety of proposed and emerging institutions for preventing, assessing, valuing, and redressing the environmental consequences of war. It takes as its starting point the existence of a relevant framework of international law that defines the scope of the issues, creates and empowers institutions to address these issues, and devises appropriate remedies. Science and economics are explored insofar as they operate in the service of this legal regime, by providing the necessary factual elements of proof, defining the extent of damage and causation, and placing an economic value on the damages to be awarded.

At the same time, science and economics necessarily interact with and help shape the legal regime. For instance, the ability of ecological and public health sciences to predict long-term damage currently is quite limited. As a result, it is difficult, if not impossible, to discern the full extent of damage immediately after it occurs. In the peacetime context, this has occasionally required long-term environmental monitoring and remediation programs, although the legal profession generally favors closure and prefers to adjudicate all issues, including the amount of damages, as early

[22] For a review of the relevant legal, economic, and scientific literature, see Environmental Law Institute, *Annotated Bibliography* (June 1998) (prepared for the First International Conference on Addressing Environmental Consequences of War: Legal, Economic, and Scientific Perspectives), available at http://www.eli.org/pdf/annotated.pdf; for a review of some of the major legal initiatives to address wartime environmental damage after the 1990–91 Gulf War, see Michael N. Schmitt, "War and the Environment: Fault Lines in the Prescriptive Landscape," chapter 3 in this volume.

as possible. Similarly, the lack of economic valuation techniques that apply reliably to wartime environmental damages may have contributed heavily to the decision to focus on environmental assessment, remediation/restoration, and monitoring costs following recent conflicts in Colombia and the 1990–91 Gulf War.

Part I of the book surveys the ethical, moral, and religious bases for constraining the environmental consequences of war. While many of the predominant religious and ethical traditions mandate respect for the environment, and some specifically impose limits on militaries when it comes to environmental harm, it is worth considering (and this book does not seek to answer) to what extent these tenets are universally held. Part I also frames a series of overarching threshold questions that subsequent parts seek to address.

Building on these basic principles, Part II examines the legal framework for preventing, assessing, remediating, and assigning liability for wartime environmental damage. Section A focuses on the international law-of-war and humanitarian law provisions constraining wartime environmental damage and allowing redress for that damage. This section highlights various inadequacies in the existing legal framework and suggests different ways of resolving these issues within the law-of-war context. One particular gap – the dearth of norms governing internal armed conflicts – proves particularly problematic. Section B canvasses legal regimes other than the law of war to highlight relevant legal principles, experiences, and mechanisms that could help clarify the existing law of war and fill in gaps. For instance, in considering the various international and national experiences with environmental damage, different authors converge on recommending a remediation fund that would supplement the emerging civil and criminal norms.

Part III examines a range of techniques and issues relating to the scientific assessment of ecological impacts (Section A) and public health impacts (Section B). Experience with major peacetime environmental catastrophes such as oil spills, deforestation, and wildlife destruction provides some basis for assessing wartime environmental damage. Moreover, some of the tools for assessing damage have been developed specifically to weigh the impacts of military preparation, highlighting the link between the preparations for and the actual conduct of war. However, in wartime as in peacetime, long-term environmental impacts are notoriously difficult

to predict with any accuracy; in fact, experience has shown that even short-term impacts can be seriously under- or over-estimated.

Part IV presents a range of economic methodologies for valuing ecological and natural resource damages and public health damages. In economics, the exceptional nature of war becomes particularly acute. Although there are a wealth of well-developed methodologies for valuing peacetime damages, the contributors raise a host of difficulties in applying these methodologies to a wartime context, where damage is on a larger scale and more severe than typically considered, the infrastructure for redressing the damage is taxed beyond normal, and the cultural assumptions relied upon by these mostly Western methodologies may not extend to other cultures.

Such methodological difficulties highlight a need for more research on the subject, but they also suggest that the legal regime may need modifications to account for the limitations of the existing scientific assessment and economic valuation techniques. For instance, difficulties in long-term assessment suggest the need for immediate mitigation and restoration action coupled with long-term monitoring and remediation in order to restore fully the injured party to its prewar state. On the other hand, a lack of internationally agreed-upon economic valuation techniques for wartime environmental damage suggests that the legal system may need to reconsider the relevance to war of the range of compensable environmental damages normally awarded in peacetime.

Looking forward, Part V examines a range of underutilized and proposed international mechanisms for preventing, assessing, and punishing wartime environmental damage. These include a proposed convention on special protected areas, akin to the Cultural Property Convention; the inspection mechanism of the Chemical Weapons Convention, which provides a comprehensive tool for investigating claimed violations of that convention, and whose experience could provide for an analogous mechanism for investigating claims of wartime environmental wrongs; the Article 90 inspection mechanism of Protocol I; and the nascent International Criminal Court, which includes environmental war crimes in its purview.

Not explicitly addressed in this volume are a number of other important relationships between war and environmental protection, in particular the various strands of thought that are loosely grouped under the heading

of "environmental security."[23] Rather simply put, this inquiry concerns itself with how shortages of natural resources and other environmental stresses lead to disputes that can escalate to armed conflict – the environmental *causes* of war rather than the environmental effects of war. Still, there is no doubt that the two topics are related: Excessive wartime damage to civilian resources or the needs of displaced refugee populations can destabilize the transition to peace, leading to a vicious cycle of further conflict and environmental damage. Conversely, an increased emphasis on peacetime environmental cooperation can both bring former combatants closer together – as with the Central American "Peace Parks"[24] – or prevent conflict from occurring in the first place.[25] Clearly, these possibilities also warrant further investigation.

Finally, the Epilogue considers in detail the 1999 Kosovo conflict, which serves as a case study of many of the unresolved legal and methodological issues in preventing, assessing, valuing, and assigning responsibility and liability for wartime environmental damage. Sadly, the Kosovo conflict also highlights the fact that wartime environmental damage is likely to remain an issue for some time to come, particularly until the relevant legal norms are clarified and strengthened and the necessary institutions established and empowered to enforce these norms.

[23] E.g., Arthur H. Westing, "The Environmental Component of Comprehensive Security," *Bull. Peace Proposals* 20 (1989), 129–34; Thomas F. Homer-Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *Int'l Security* 16 (1991), 76; Robert D. Kaplan, "The Coming Anarchy," *Atlantic Monthly* 273(2) (Feb. 1994), 44.

[24] E.g., Jeffrey A. McNeely, "War and Biodiversity: An Assessment of Impacts," chapter 14 in this volume; Lothar Brock, "Peace Through Parks: The Environment on the Peace Research Agenda," *J. Peace Res.* 28 (1991), 407–23; see also Ricardo A. Navarro, "The Environmental Consequences of War: The Case of El Salvador," paper delivered at the First International Conference on Addressing Environmental Consequences of War: Legal, Economic, and Scientific Perspectives, Washington, D.C. (June 1998) (manuscript on file with editors) (describing "Forests of Reconciliation").

[25] E.g., Deborah Sandler et al. (eds.), *Protecting the Gulf of Aqaba: A Regional Environmental Challenge* (Washington: Environmental Law Institute, 1993); Moshe Hirsch, "Environmental Cooperation between Former Belligerents in the Middle East: Some Structural Factors" (May 1998) (manuscript on file with editors).