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# Limiting the Precautionary Principle: Weapons Regulation in the Face of Scientific Uncertainty

Lesley Wexler\*

*Conventional wisdom suggests that the precautionary principle, which places the burden for proving a product's safety on the manufacturer, best protects the environment and the public's health in cases of scientific uncertainty. Using insights from behavioral law and economics, this Article contends that the precautionary principle may lead to perverse environmental prioritization in the military context. It uses depleted uranium weapons as a case study to demonstrate the military precautionary principle's insufficient attention to risk-risk trade-offs and its systemic susceptibility to cognitive biases such as the availability heuristic, blame attribution errors, and myopia to older risks. The Article instead proposes an amendment to existing international law to create an ongoing duty for states to evaluate the unintended environmental and health threats of weapons. Such an amendment to Article 36 of Protocol I to the Geneva Convention could help provide the information needed for a global weapons toxics registry and foster the deployment of cleaner weaponry.*

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\* University of Chicago School of Law, Bigelow Teaching and Research Fellow. Many thanks to Cass Sunstein, Adrian Vermeule, Alan Sykes, Douglas Baird, Timothy Wu, Rachel Brewster, Elizabeth Emens, Amelia Smith, Andy Ryan, and Bill Roberts for reviewing drafts.

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## INTRODUCTION

With the recent memories of Kuwaiti oil fires, the reports of Gulf War Syndrome, and the development of new war-fighting technologies,<sup>1</sup> regulating the environmental consequences of conflict grows increasingly important. Technological developments raise the troubling question of how to regulate warfare under conditions of uncertainty about the health and environmental effects of new weapons. Existing scholarship struggles with the choice of whether to regulate the deployment of new weapons systems or to devote those regulatory resources to the enforcement of existing laws of war.

The precautionary principle, which encourages action on environmental problems before the cause and effect relationship of a pollutant and a potential harm has been established, offers one possible approach to the problem of scientific uncertainty with regards to new weapons systems. Imported from peacetime contexts, a military precautionary principle calls for a case-by-case consideration of newly developed weapons systems. For instance, the push for a ban on depleted uranium weapons ("DUWs"), a type of tank ammunition and armor, provides an illuminating case study of the precautionary approach. Environmental advocates contend that the use of DUWs caused many of the health problems now seen in Iraqi civilians and U.S. military personnel. Although no scientific consensus exists on the nature of a cause and effect relationship between DUWs and numerous health harms, many activists urge a DUWs ban and a clean up of existing contamination until the military establishes their safety.

Drawing on cognitive bias literature, this Article suggests that a focus on individual weapon prohibitions often fails to protect against the most serious health and environmental harms. As the attention focused on DUWs demonstrates, nongovernmental organizations ("NGOs") and the public will concentrate on those weapons with the most easily imagined and feared risks. Older weapons, to which the public may have grown inured, often pose equal or greater risks, but they are less likely to raise alarm. A military precautionary principle often fails to prioritize those actions that best promote the public health and the environment. Even when significant health and environmental harms are addressed, the case-by-case approach to the precautionary principle fails to compare a

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<sup>1</sup> Laurent R. Hourcle, *Environmental Law of War*, 25 VT. L. REV. 653, 660 (2001) (expressing concern that new weapons create damage that is both "directly and collaterally much more severe").

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given weapon to its reasonable alternatives. In many cases, those alternatives present similar types of risks to potentially affected populations. In addition, the adoption of a military precautionary principle may keep greener weapons off the battlefield.

Part I introduces the precautionary principle and its various formulations. This section offers the numerous theoretical justifications for a domestic precautionary principle. It then details the controversy surrounding the use of DUWs and how the precautionary principle addresses this issue. Part II provides the existing international law background and explains how these regulations apply to DUWs. This discussion begins with the relevant environmental and health protections in the laws of war treaties. It also considers the precautionary principle's status as customary international law and whether such customary international law applies during conflict.

Part III uses DUWs as an example to identify the limitations of a military precautionary principle. First, the Article explains why DUWs may not satisfy the threshold needed to trigger the precautionary principle's protections. Second, it highlights the problems of using a case-by-case precautionary approach. By failing to compare DUWs to their reasonable substitutes, a military precautionary principle is insufficiently attentive to risk-risk problems. By doing a first cut comparison of alternatives, this Article reveals the limited health and environmental gains of a DUWs ban. It identifies some of the risks raised by cleanup and discusses some of the consequences of military and financial cost insensitivity.

Part IV identifies the relevant cognitive biases fueling the regulatory focus on DUWs and explains why these biases systematically encourage suboptimal weapons regulation. For instance, this section explores the availability heuristic — a mental shortcut that makes people more attuned to risks that are easily called to mind. This paper contends that the availability heuristic influences NGOs and the public to focus on the most salient and visible risks rather than the most serious ones. This section also utilizes certain aspects of attribution theory — specifically, the desire to blame an illness on a particular source rather than chance. Attribution theory explains the public's heightened desire to regulate weapons after conflict. Additionally, the Article discusses why acceptance of background risks makes the public unlikely to develop a systematic approach to weapons-related risks. Instead, the public is prone to advocate regulation of new weapons after their initial uses but to ignore other weapons with similar risks. Finally, this section suggests

that a weapon-by-weapon approach may systematically disadvantage technologically advanced states. This may either undermine compliance with international law or discourage countries from developing environmentally-friendly war-fighting technologies.

Part V grapples with the difficulties of developing a regulatory response to the problem of uncertainty. It proposes an amendment to article 36 of the 1977 Protocol I to the Geneva Convention. Such an amendment would create an ongoing duty for states to determine whether their weapons comply with the environmental and civilian protections of international law. This Article suggests some guidelines to help identify the proper studies for states to undertake in their compliance reviews. The proposed amendment also provides momentum for a global information registry about weapon toxicity. Such a registry makes militaries' scientific and value choices more transparent, while it allows those with the most information to balance environmental and health priorities with military objectives.

#### I. ENVIRONMENTAL ARGUMENT FOR BANNING DEPLETED URANIUM WEAPONS

With the increasing strength of the environmental movement and greater awareness of the dangers of warfare, some have advocated the expansion of the precautionary principle to the military context. In particular, these advocates believe that the precautionary principle should guide the determination of acceptable battlefield weapons. This section articulates the many aspects of the precautionary principle so that its application to new weapons, such as DUWs, can be better understood.

##### A. Precautionary Principle

The precautionary principle is a strategy to guide policy in the face of scientific uncertainty about the environmental and health consequences of human action.<sup>2</sup> The precautionary principle encompasses several basic conceptions about how regulators should approach the public health and the environment. First, regulators ought to act to protect people before definitive scientific proof of harm has been provided.<sup>3</sup> So,

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<sup>2</sup> Tim O'Riordan et al., *The Evolution of the Precautionary Principle*, in REINTERPRETING THE PRECAUTIONARY PRINCIPLE 9, 9 (Tim O'Riordan et al. eds., 2001).

<sup>3</sup> *Id.* at 19.

for example, although scientific disagreement exists over the extent to which human activities hasten global warming, the precautionary principle suggests that policymakers act now to prevent future warming. Second, the precautionary principle encourages policymakers to directly involve those most likely to be disadvantaged by unrestricted action.<sup>4</sup> For instance, if a company wants to site a hazardous waste facility in a low income neighborhood, regulators should consider input from the relevant community. Third, the precautionary principle shifts the burden of proof of harm away from those likely to suffer harm and onto those desiring to change the status quo.<sup>5</sup> So to continue with the siting example, if the local public is concerned that the facility will pollute the local water supply and thus cause significant health problems, the company must disprove the likelihood of the health problems before building the facility. In contrast, without the precautionary principle, a community might be forced to bring evidence of harm after the siting in hopes of having the facility shut down or further regulated.

The precautionary principle also challenges conventional technocratic approaches to the probability and magnitude of environmental risk — it adds in an extra level of protection.<sup>6</sup> It presents an alternative to risk assessment and other frameworks thought to be insufficiently sensitive to pervasive scientific uncertainty, hidden scientific presumptions, and underlying value choices.<sup>7</sup> To take one example, conventional wisdom might suggest that a certain carcinogenic agent is safe in small doses, even if animal studies show that large doses can cause cancer. Given our uncertainty about the correct extrapolation from high doses to low doses, the precautionary principle suggests that we should build an extra margin of safety into our regulation of that carcinogen. In short, the precautionary principle embodies the adage that we are “better off safe than sorry.”<sup>8</sup>

No definitive formulation of the precautionary principle exists; rather, various iterations inform policymakers. For instance, principle 15 of the Rio Declaration articulates the precautionary principle in the following

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<sup>4</sup> *Id.* at 13.

<sup>5</sup> *Id.* at 20.

<sup>6</sup> Tim O’Riordan, *The Politics of the Precautionary Principle*, in PERSPECTIVES ON THE PRECAUTIONARY PRINCIPLE 283, 294 (Ronnie Harding & Elizabeth Fisher eds., 1999).

<sup>7</sup> Ronnie Harding, *Toxics, Industry, & Precaution: What Role for Science*, in PERSPECTIVES ON THE PRECAUTIONARY PRINCIPLE, *supra* note 6, at 209, 215.

<sup>8</sup> David E. Adelman, *Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law*, 79 NOTRE DAME L. REV. 497, 543 (2004).

manner: “[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”<sup>9</sup> The Wingspread Statement, developed by an international group of scientists, government actors, and environmentalists, presents a stronger version of the precautionary principle.<sup>10</sup> It omits a threshold level of harm and squarely places the burden of proof on an activity’s proponent.<sup>11</sup> Environmental groups have constructed still another version that calls for the prohibition of activities when there is a “risk of significant health or environmental damage . . . and when there is scientific uncertainty as to the nature of that damage or the likelihood of the risk.”<sup>12</sup> Finally, a synthesis of many different legal formulations suggests, “in the presence of a threat of (non-negligible) environmental harm accompanied by scientific uncertainty, regulatory action should nevertheless be taken to prevent or remedy the hazard concerned.”<sup>13</sup> The distinctions between these versions have substantial regulatory import: they have different thresholds for when risk falls under the precautionary principle, they employ varied definitions of scientific uncertainty, and they dictate distinct regulatory outcomes.

The precautionary principle can be defended under numerous theories of environmental regulation. Traditional accounts of regulation suggest that policymakers and markets are undersensitive to long-term environmental harms.<sup>14</sup> These cumulative environmental harms may

<sup>9</sup> U.N. Conference on Environment and Development, June 3-14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1 (Aug. 12, 1992). The United States signed but never ratified the Rio Declaration. See Rebecca Bratspies, *The Illusion of Care: Regulation, Uncertainty, and Genetically Modified Food Crops*, 10 N.Y.U. ENV’T L.J. 297, 317 n.88 (2002).

<sup>10</sup> Nicholas Ashford et al., *Wingspread Statement on the Precautionary Principle* (Jan. 23-25, 1998), <http://www.greenpeace.org.au/toxics/pdf/wingspread.pdf>.

<sup>11</sup> *Id.* (“Where an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not established fully. In this context, the proponent of an activity, rather than the public, should bear the burden of proof.”).

<sup>12</sup> Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1013 (2003) (citing *Capitol Hill Hearing Testimony Concerning the Cloning of Humans and Genetic Modifications Before the Subcomm. on Labor, Health, and Human Servs., S. Appropriations Comm.*, 107th Cong. (2002) (statement of Dr. Brent Blackwelder, President, Friends of the Earth)).

<sup>13</sup> ARIE TROUWBORST, *EVOLUTION AND STATUS OF THE PRECAUTIONARY PRINCIPLE IN INTERNATIONAL LAW* 52 (2002) (emphasis omitted).

<sup>14</sup> Zygmunt J.B. Plater, *From the Beginning, a Fundamental Shift of Paradigms: A Theory*

cause natural systems to reach a critical threshold and collapse under the collective stress. For instance, as mentioned earlier, the unchecked effect of fossil fuel emissions may result in runaway global warming. Yet, left to their own devices, regulators fail to provide the breathing space for nature's critical processes.<sup>15</sup> Adopting the precautionary principle would dictate a regulatory response to greenhouse gas emissions despite the lack of consensus on the cause and effect relationships thought to produce fast rates of global warming.

Supporters also defend the precautionary principle as being information-producing.<sup>16</sup> Under this explanation, the status quo fails to provide the necessary studies to allow policymakers to make informed decisions about the relation between regulated activities and environment and human health. It is extremely expensive and sometimes impossible for the government to replicate the conditions under which toxins are produced. Meanwhile, companies lack the proper incentives to test for environmental and health problems or to reveal the negative information to regulators. The precautionary principle forces those with best access to the information about a given process or pollutant to provide this information to the public or forgo placing their product on the market. For instance, the U.S. Food and Drug Administration's requirement of rigorous testing before a pharmaceutical can reach the market exemplifies the information-producing aspects of the precautionary principle.

Another justification, supported by public choice theory, suggests that most environmental regulations potentially benefit a large, dispersed group, while the losses are accrued by a smaller, discrete group.<sup>17</sup> Thus, the transaction costs for mobilizing the cost bearers are substantially lower than they are for mobilizing the risk-bearers. Under this account, the wealth and experience of corporate lobbies allows them to both dominate the agenda and influence regulatory outcomes. A more sophisticated variation of this account suggests that even when the public sets the agenda for greater environmental protection, various

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and *Short History of Environmental Law*, 27 LOY. L.A. L. REV. 981, 996-98 (1994).

<sup>15</sup> Timothy O'Riordan & James Cameron, *The History and Contemporary Significance of the Precautionary Principle*, in INTERPRETING THE PRECAUTIONARY PRINCIPLE 12, 13 (Timothy O'Riordan & James Cameron eds., 1994).

<sup>16</sup> Wendy Wagner, *Commons Ignorance: The Failure of Environmental Law to Produce Needed Information on Health and the Environment*, 53 DUKE L.J. 1619, 1725 (2004).

<sup>17</sup> Amy Sinden, *In Defense of Absolutes: Combating the Politics of Power in Environmental Law*, 90 IOWA L. REV. 1405, 1410 (2005).



interest groups manipulate such legislation to serve their own ends.<sup>18</sup> The precautionary principle returns regulation to its supposed real purpose of serving the public good.

Behavioral law and economics adds another explanation for the insensitivity of markets and the undermobilized public.<sup>19</sup> As informed by the cognitive bias literature, this perspective suggests that the public systematically underprotects the environment because of a myopia about long-term environmental losses coupled with a desire to avoid immediate economic losses associated with environmental regulation.<sup>20</sup> In addition, behavioral law and economics scholars suggest that technocrats and scientists often fail to recognize the possibility of unpredicted, synergistic, and cumulative effects of human action.<sup>21</sup> In other words, regulators underestimate how living in a world filled with interactions that are often untested in scientific experiments makes potential environmental problems harder to forecast and manage. Thus, the precautionary principle counteracts this systematic underprotection of the environment by presuming unanticipated harms until they are disproven.

Another rationale champions the precautionary principle as a way to democratize scientific decision-making. Under this view, technocrats dominate health and environmental agenda setting. They are insufficiently attentive to the concerns of everyday people and the distributional effects of actual environmental regulations. Their chosen methodologies and scientific presumptions favor increased pollution and less stringent regulation. By shifting the burden of proof, the precautionary principle forces technocrats to submit their underlying presumptions to public scrutiny.

Many legal scholars extend these justifications of the precautionary principle to the wartime context.<sup>22</sup> They contend that conflict situations

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<sup>18</sup> See generally BRUCE A. ACKERMAN & WILLIAM T. HASSLER, CLEAN COAL/DIRTY AIR OR HOW THE CLEAN AIR ACT BECAME A MULTIBILLION-DOLLAR BAIL-OUT FOR HIGH-SULFUR COAL PRODUCERS AND WHAT SHOULD BE DONE ABOUT IT (1981).

<sup>19</sup> See Daniel A. Farber, *Probabilities Behaving Badly: Complexity Theory and Environmental Uncertainty*, 37 U.C. DAVIS L. REV. 146, 170 (2003).

<sup>20</sup> David A. Dana, *A Behavioral Economic Defense of the Precautionary Principle*, 97 NW. U. L. REV. 1315, 1325 (2003); O'Riordan & Cameron, *supra* note 15, at 15.

<sup>21</sup> THE PRECAUTIONARY PRINCIPLE IN THE 20TH CENTURY: LATE LESSONS FROM EARLY WARNINGS 185, 187 (Poul Harremoës et al. eds., 2002); Gregory D. Fullem, Comment, *The Precautionary Principle: Environmental Protection in the Face of Scientific Uncertainty*, 31 WILLAMETTE L. REV. 495, 517-18 (1995) (discussing linkages myopia).

<sup>22</sup> Thomas Meron, *Protection of the Environment During Non-International Armed*

magnify pressures to undervalue the environment. As war planners inherently prioritize military concerns during battle, these scholars argue that the precautionary principle ought to be applied when the military first develops the tools and weapons for conflict.<sup>23</sup> The call to ban DUWs and to remediate depleted uranium ("DU") contaminated areas provides a particularly vivid example of the movement to expand the precautionary principle to the wartime context.<sup>24</sup> The following section offers some background on the DU debate and why DU use is a candidate for the precautionary principle's application.

### B. Depleted Uranium Weapons

The U.S. military currently employs DU in both antitank ammunition and protective tank armor.<sup>25</sup> The use of DU yields significant strategic benefits: (1) DUWs extend a tank's effective firing range,<sup>26</sup> (2) DUWs allow better tank penetration than traditional tungsten rounds do,<sup>27</sup> (3) DUWs set hard targets on fire,<sup>28</sup> and (4) DU armored tanks are more

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*Conflicts*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT 353, 356 (Richard Grunawalt et al. eds., 1996); Rymn James Parsons, *The Fight to Save the Planet: U.S. Armed Forces, "Greenkeeping," and Enforcement of the Law Pertaining to Environmental Protection During Armed Conflict*, 10 GEO. INT'L ENVTL. L. REV. 441, 493 (1998); Andy Rich, *The Environment: Adequacy of Protection in Times of War*, 12 PENN. ST. ENVTL. L. REV. 445, 456 (2004); Wil D. Verwey, *Observations on the Legal Protection of the Environment in Times of International Armed Conflict*, 7 HAGUE Y.B. INT'L L. 35, 51 (1994); Julie G. Yap, Note, *Just Keep Swimming: Guiding Environmental Stewardship Out of the Riptide of National Security*, 73 FORDHAM L. REV. 1289, 1335-36 (2004); Nancy Myers, *War's Side Effects: War and the Precautionary Principle*, NETWORKER, Apr. 2003, [http://www.sehn.org/Volume\\_8-2\\_3.html](http://www.sehn.org/Volume_8-2_3.html).

<sup>23</sup> Paul C. Szasz, *The Existing Legal Framework, Protecting the Environment During International Armed Conflict*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT, *supra* note 22, at 278, 282.

<sup>24</sup> J. Martin Wagner & Neil A.F. Popovic, *Environmental Injustice on United States Bases in Panama: International Law and the Right to Land Free From Contamination*, 38 VA. J. INT'L L. 401, 442-43 (1998).

<sup>25</sup> Dan Fahey, *The Emergence and Decline of the Debate Over Depleted Uranium Munitions 1991-2004*, ¶ 2.2 (June 24, 2004), <http://wise-uranium.org/pdf/duemdec.pdf>.

<sup>26</sup> DEP'T OF DEF., DEPLETED URANIUM IN THE GULF (II) 99-104 (2000), available at [http://www.gulflink.osd.mil/du\\_ii/du\\_ii\\_tabf.htm](http://www.gulflink.osd.mil/du_ii/du_ii_tabf.htm).

<sup>27</sup> Dan Fahey, *Collateral Damage: How U.S. Troops Were Exposed to Depleted Uranium During the Persian Gulf War*, in METAL OF DISHONOR: HOW THE PENTAGON RADIATES SOLDIERS AND CIVILIANS WITH DU WEAPONS 25, 26-27 (John Catalinotto & Sara Flounders eds., 1999) [hereinafter METAL OF DISHONOR] (explaining that tungsten rounds tend to mushroom on contact while DU burrows through metal).

<sup>28</sup> Rupert Pangelley, *The DU Debate: What Are the Risks?*, JANE'S DEFENCE WKLY., Jan. 15, 2001, available at [http://www.janes.com/defence/news/jdw/jdw010115\\_2\\_n.shtml](http://www.janes.com/defence/news/jdw/jdw010115_2_n.shtml).

difficult to penetrate than unarmored tanks.<sup>29</sup> The use of DUWs and DU armor shortens conflicts and reduces casualties by enhancing ground dominance. For example, the military often cites the use of DUWs as a reason for the brevity of the Gulf War.<sup>30</sup> In addition to its battlefield advantages, domestic production of DU ammunition and armor is relatively cheap compared to its likely alternatives.<sup>31</sup>

So far, the U.S. military's use of DU has been limited. The United States tested DU ammunition in Vieques, Puerto Rico;<sup>32</sup> Jefferson Proving Grounds, Indiana;<sup>33</sup> and accidentally in Okinawa, Japan.<sup>34</sup> The earliest combat application was in the deserts of Iraq and Kuwait during the Gulf War.<sup>35</sup> Since then, the United States has also deployed DUWs and DU armor in Kosovo,<sup>36</sup> Serbia,<sup>37</sup> and again in Iraq.<sup>38</sup> Meanwhile, the United States has conducted only minimal remediation efforts of DUWs and DU armor.<sup>39</sup>

DU's military applications have not yet been widely proliferated to

<sup>29</sup> Fahey, *supra* note 25, ¶ 2.2.

<sup>30</sup> Jack Spencer & Michael Scardaville, *Dispelling the Myths About Military Use of Depleted Uranium*, HERITAGE FOUNDATION EXECUTIVE MEMORANDUM, Feb. 20, 2001, available at <http://www.heritage.org/Research/NationalSecurity/EM721.cfm>.

<sup>31</sup> The Department of Defense ("DOD") provides DU, a waste product, free of cost to weapons manufacturers. Sara Flounders, *The Struggle for an Independent Inquiry*, in METAL OF DISHONOR, *supra* note 27, at 3, 5, 9.

<sup>32</sup> Physicians for Social Responsibility, *Issue Brief: Depleted Uranium Weapons* (July 1999), <http://www.vieques-island.com/navy/du.html>.

<sup>33</sup> GlobalSecurity.org, *Jefferson Range/Jefferson Proving Grounds* (May 14, 2002), <http://www.globalsecurity.org/military/facility/jefferson.htm>.

<sup>34</sup> Yuri Kageyama, *U.S. Says Uranium Bullets Fired Near Japan*, PHILA. INQUIRER, Feb. 11, 1997, at A7.

<sup>35</sup> Fahey, *supra* note 27, at 26-27.

<sup>36</sup> Fahey, *supra* note 25, ¶ 2.3.

<sup>37</sup> Cristina Giannardi & Daniele Dominici, *Military Use of Depleted Uranium: Assessment of Prolonged Population Exposure*, 64 J. ENVTL. RADIOACTIVITY 227, 227 (2003).

<sup>38</sup> Dan Fahey, *The Use of Depleted Uranium in the 2003 Iraq War: An Initial Assessment of Information and Policies* 4-5 (June 24, 2003), <http://www.wise-uranium.org/pdf/duiq03.pdf>.

<sup>39</sup> The Navy and Marines recovered some of the DU shells and penetrators they released in Vieques and Okinawa. See Akira Tashiro, *DU Munitions in Okinawa* (2000), [http://www.chugoku-np.co.jp/abom/uran/okinawa\\_e/index2.html](http://www.chugoku-np.co.jp/abom/uran/okinawa_e/index2.html); Associated Press, *Study Examines Vieques Radiation*, NUCNEWS, Oct. 4, 2000, <http://nucnews.net/nucnews/2000nn/0010nn/001004nn.htm#05>. The deserts of Iraq remain contaminated from the first and now second Gulf Wars. Fahey, *supra* note 27, at 31. The Pentagon declined to clean up the 10,000 rounds fired in Kosovo. J. J. Richardson, *Depleted Uranium: The Invisible Threat*, MOTHER JONES, June 23, 1999, available at [http://www.motherjones.com/news/special\\_reports/total\\_coverage/kosovo/reality\\_check/du.html](http://www.motherjones.com/news/special_reports/total_coverage/kosovo/reality_check/du.html).

other countries. Only a few states possess the capacity to produce DU, and of those, only the United States and the United Kingdom admit to combat use of DUWs.<sup>40</sup> But arms control experts suspect that at least eight states without declared production capabilities possess DU ammunition.<sup>41</sup> Given DU's strategic advantages, other states will likely attempt to acquire DUWs and DU armor.<sup>42</sup>

### C. DU's Potential Health and Environmental Effects

A controversy is emerging over DU's potential health and environmental effects. Military personnel, civilians, post-conflict peacekeepers, and relief workers face potential DU exposure through inhalation, ingestion, embedded fragments, and/or external irradiation.<sup>43</sup> First, troops in coated tanks receive radiation doses from the tanks' DU armor.<sup>44</sup> Generally speaking, the longer the conflict lasts, the greater the exposure troops face. In addition, friendly fire explosions threaten troops within the immediate vicinity of the injured tank, along with any rescue personnel.<sup>45</sup> Ground troops are often also exposed to contaminated vehicles after the immediate conflict. When DU ammunition hits an object and/or catches on fire, it produces small DU dust particles.<sup>46</sup> If fighting takes place in or near populated areas, civilians and relief workers may inhale DU particles long after the actual fighting ends.<sup>47</sup> Those who salvage parts and goods from contaminated vehicles face additional inhalation exposure. Children who play near discarded war materials may experience both inhalation and ingestion exposure.<sup>48</sup> In addition, as DU munitions corrode, they leach into the

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<sup>40</sup> Fahey, *supra* note 25, ¶ 2.3.

<sup>41</sup> These states include Egypt, Israel, Kuwait, Saudi Arabia, the United Arab Emirates, Turkey, Thailand, and Taiwan. Dan Fahey, *Use, Effects and Legal Standing of Depleted Uranium Munitions* 3 (Dec. 10, 2001), <http://doc.danfahey.com/Legal.pdf>.

<sup>42</sup> Dan Fahey, *Depleted Uranium Weapons: Lessons from the 1991 Gulf War in DEPLETED URANIUM: A POSTWAR DISASTER FOR ENVIRONMENT AND HEALTH* (1999), <http://www.ratical.org/radiation/dhap/index.html#>.

<sup>43</sup> A. Bleise et al., *Properties, Use and Health Effects of Depleted Uranium (DU): A General Overview*, 64 J. ENVTL. RADIOACTIVITY 93, 99-100 (2002).

<sup>44</sup> *Id.* at 104.

<sup>45</sup> *See id.* at 101-02. The longer the conflict, the greater the exposure.

<sup>46</sup> *Id.* at 97 (estimating that "normally 10-35% (and a maximum of 70%) of the DU penetrator" becomes dust on impact).

<sup>47</sup> While there is debate about the distance particles may travel, it is clear they travel downwind. *Id.*

<sup>48</sup> Giannardi & Dominici, *supra* note 37, at 233 (identifying children playing with soil as

groundwater and contaminate agricultural systems, which exposes an even larger population.<sup>49</sup>

DU poses a variety of possible health and environmental risks. The two most cited concerns stem from DU's chemical toxicity and radioactivity. Chemical toxicity is common to all heavy metals, many of which are present on the battlefield and even in everyday life, like lead. Chemical poisoning weakens the immune system and in some instances, results in acute respiratory conditions<sup>50</sup> and severe kidney problems.<sup>51</sup> Similarly, radiation creates long-term risks of cancers, Chronic Fatigue Syndrome, and auto-immune deficiencies.<sup>52</sup> In addition to these risks, DU may also be genotoxic. Genotoxic substances alter DNA, often in ways that increase the chances of genetic birth defects and cancer.<sup>53</sup> The environmental risks stem from DU's persistence in the environment — it has an exceptionally long half-life.<sup>54</sup> These risks are not well-documented, as anthropocentric concerns about DUWs dominate the scientific and policy literature.<sup>55</sup>

Scientific uncertainty and disputes about basic methodological choices confound efforts to quantify DU's harms. Although the military application of DU was first approved in the 1970s,<sup>56</sup> scientists only began to conduct substantial health and environmental studies on DU in the

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critical population group). Moreover, some scientific evidence suggests that women and children are at the greatest risk for DU-related illnesses. Rosalie Bertell, *Depleted Uranium as a Weapon of War* (Aug. 1999), [http://www.iicph.org/docs/DU\\_Human\\_Rights\\_Tribunal.htm](http://www.iicph.org/docs/DU_Human_Rights_Tribunal.htm).

<sup>49</sup> KAREN HULME, *WAR TORN ENVIRONMENT: INTERPRETING THE LEGAL THRESHOLD* 247 (2004).

<sup>50</sup> See The Royal Society Working Group on the Health Hazards of Depleted Uranium Munitions, *The Health Effects of Depleted Uranium Munitions: A Summary*, 22 J. RADIOLOGICAL PROTECTION 131, 134 (2002).

<sup>51</sup> Panayotis A. Assimakopoulos, *Editorial*, 64 J. ENVTL. RADIOACTIVITY 87, 87 (2002).

<sup>52</sup> Trisha T. Pritikin, *Hanford: Where Traditional Common Law Fails*, 30 GONZ. L. REV. 523, 527 (1995).

<sup>53</sup> Lauren Zeise, *Risk Assessment of Genotoxic Carcinogens*, in GENETIC TOXICOLOGY AND CANCER RISK ASSESSMENT 321, 322 (Wai Nang Choy ed., 2001).

<sup>54</sup> Estimates range as high as 4.4 billion years. Ramsey Clark, *An International Appeal to Ban the Use of Depleted Uranium Weapons*, in METAL OF DISHONOR, *supra* note 27, at 21, 22.

<sup>55</sup> DU might threaten ecosystems and individual animal and plant species, however the DU literature does not focus on the intrinsic value of the environment. See e.g., Section VI: *Environmental Cost of Gulf War to Iraqis and Others*, in METAL OF DISHONOR, *supra* note 27, at 155, 155-82 (discussing potential environmental consequences in terms of how they might affect humans).

<sup>56</sup> Bernard Rostker, *Environmental Exposure Report: Depleted Uranium in the Gulf (II)* tab e (Dec. 13, 2000), [http://www.deployementlink.osd.mil/du\\_library/du\\_ii/du\\_ii\\_tabe.htm#tabe](http://www.deployementlink.osd.mil/du_library/du_ii/du_ii_tabe.htm#tabe).

mid-1990s.<sup>57</sup> In the wake of the Gulf War, no one conducted comprehensive surveys of civilian populations exposed to DU.<sup>58</sup> This means most of our DU knowledge comes either from studies in which animals are exposed to DU and those results are extrapolated to humans or from pre-existing studies about chemical and radioactive toxicity.

Meanwhile, the larger scientific debate about low-level radiation complicates the efforts to reach a consensus about the likely range of harm posed by DUWs. Significant disagreement exists about how to measure the effect of low-level radiation on humans; the possibilities include: a linear no-dose threshold model,<sup>59</sup> a linear quadratic model,<sup>60</sup> and a hormetic j-curve.<sup>61</sup> Under the linear no-dose threshold model, radiation exposure poses a risk directly proportional to the amount of exposure. No “safe limit” exists — even very slight exposures raise the possibility of some short-term or long-term damage.<sup>62</sup> In the linear quadratic model, as exposure declines, the risk declines in an exponential, rather than a linear, fashion. Under this model, the low-dose risk is substantially depressed and often considered to be safe.<sup>63</sup> In the hormetic model, high-dose exposure presents a similar risk as in the linear no-dose and linear quadratic models, but very low doses stimulate a beneficial health effect.<sup>64</sup> Even after picking a model, however, contextual questions about actual usage and exposure rates remain.

Some scientists also contend that synergistic interaction<sup>65</sup> with other toxins in the environment<sup>66</sup> enhances the risks posed by DU. Under this

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<sup>57</sup> Fahey, *supra* note 27, at 37.

<sup>58</sup> *Id.*

<sup>59</sup> Bleise et al., *supra* note 43, at 108 (“[T]he additional cancer rate for low dose exposure is assumed to be proportional to the radiation dose . . .”).

<sup>60</sup> George K. Tokuhata, *Three Mile Island and Public Health Consequences*, in PHANTOM RISK: SCIENTIFIC INFERENCE AND THE LAW 279, 281 (Kenneth R. Foster et al. eds., 1993) [hereinafter PHANTOM RISK].

<sup>61</sup> Frank B. Cross, *Paradoxical Perils of the Precautionary Principle*, 53 WASH. & LEE L. REV. 851, 863-96 (1996) (explaining paradoxical result that “substance presenting a mortality risk at high levels of exposure” can protect against disease and death at low-levels of exposure).

<sup>62</sup> Ludwig Feinendegen & Myron Polycove, *Biologic Responses to Low Doses of Ionizing Radiation: Detriment Versus Hormesis*, 42 J. NUCLEAR MED. 17, 17 (2001), available at <http://cnts.wpi.edu/RSH/Docs/Polycove/LF-MP0701JNM.pdf>.

<sup>63</sup> See D.J. Brenner et al., *The Linear-Quadratic Model and Most Other Common Radiobiological Models Result in Similar Predictions of Time-Dose Relationships*, 150 RADIATION RES. 83, 85 (1998).

<sup>64</sup> CASS SUNSTEIN, LAWS OF FEAR: BEYOND THE PRECAUTIONARY PRINCIPLE 30-31 (2005).

<sup>65</sup> Synergy occurs when a toxin promotes the negative potential of another toxin. Peter Huber, *The Old-New Division in Risk Regulation*, 69 VA. L. REV. 1025, 1085 (1983).

<sup>66</sup> Duncan Graham-Rowe, *Depleted Uranium Casts Shadow Over Peace in Iraq*, NEW

theory, a toxin that may pose relatively low risks when used in isolation may become more dangerous when used in combination with a second toxin. The amount of danger increases exponentially rather than just cumulatively, so that relatively low-risk doses of two different toxins might together create a much greater threat than they pose separately. Thus, what makes DU so potentially dangerous is neither its heavy metal content nor its radioactive properties, but the two components mixed together. This account also suggests that scientists should study DU exposure in combination with other potentially dangerous agents used in combat, like defoliants, pesticides, and vaccines.

The U.S. military and many scientists contend that both external<sup>67</sup> and internal DU exposure pose negligible threats to human health and the environment.<sup>68</sup> These DU supporters downplay any effects from radioactivity<sup>69</sup> and suggest that chemical toxicity risks are insignificant.<sup>70</sup> DU supporters mostly rely on a few scientific reviews and some limited human studies of Gulf War veterans.<sup>71</sup> For instance, DUWs supporters frequently rely on a report from the nonprofit RAND Institute as being an authoritative literature review.<sup>72</sup> Although fairly comprehensive, the RAND report relies mostly on studies and data about natural uranium and has been faulted for failing to review sources concluding that DU

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SCIENTIST, Apr. 15, 2003, available at <http://www.newscientist.com/article.ns?id=dn3627>.

<sup>67</sup> Bleise et al., *supra* note 43, at 104 (“In view of the low occupancy factor for such [military] vehicles, additional annual exposures are small in comparison with natural radiation doses, and potential health effects insignificant.”).

<sup>68</sup> Dan Fahey, *Unresolved Issues Regarding Depleted Uranium and the Health of U.S. Veterans of Operation Iraqi Freedom and Operation Enduring Freedom* 5 (Mar. 24, 2004), <http://doc.danfahey.com/unresolvedissues.pdf> (quoting DOD as stating it has “no reason to believe [soldiers’] uranium levels will have any negative impacts on [their] health”). See generally Melissa A. McDiarmid et al., *Health Effects of Depleted Uranium on Exposed Gulf War Veterans: A 10-Year Follow-Up*, 67 J. TOXICOLOGY & ENVTL. HEALTH 277 (2004). For instance, the government contends that the collective cancer risk for Iraq is only 10 deaths over the lifetimes of the nearly one million people exposed during the first Gulf War. Steve Fetter & Frank von Hippel, *After the Dust Settles*, BULL. ATOM. SCI., Nov.-Dec. 1999, at 42-45. They also argue that DUWs present a similarly minimal threat to the food chain. *Id.*; see also Bleise et al., *supra* note 43, at 93.

<sup>69</sup> Fetter & von Hippel, *supra* note 68, at 45.

<sup>70</sup> U.S. ARMY CTR. FOR HEALTH PROMOTION & PREVENTIVE MED. & THE U.S. ARMY HEAVY METALS OFFICE, DEPLETED URANIUM AEROSOL DOSES AND RISKS: SUMMARY OF U.S. ASSESSMENTS 5.6, 6.5 (Oct. 2004), available at [http://www.deploymentlink.osd.mil/du\\_library/du\\_capstone/index.pdf](http://www.deploymentlink.osd.mil/du_library/du_capstone/index.pdf).

<sup>71</sup> Jason A. Beckett, *Interim Legality: A Mistaken Assumption? — An Analysis of Depleted Uranium Munitions Under Contemporary International Humanitarian Law*, 3 CHINESE J. INT’L L. 43, 49-50 (2004).

<sup>72</sup> *Id.*

poses demonstrable health risks.<sup>73</sup> Similarly, many epidemiological (human) studies cited in support of DU also suffer from incompleteness.<sup>74</sup>

On the other side of the debate, activists claim that DU causes Gulf War Syndrome,<sup>75</sup> a massive increase in the cancer rate,<sup>76</sup> and widespread birth defects.<sup>77</sup> They contend that the government massively overestimates the utility of DU.<sup>78</sup> These activists distrust government research which they consider to be unduly optimistic and dishonest;<sup>79</sup> in particular, they criticize the military for failing to disclose amounts and locations of DU used.<sup>80</sup> Although some DU activists make credible claims, others seem to lack a scientific foundation.<sup>81</sup> Many of their studies have not been peer-reviewed and rely instead on anecdotal evidence.<sup>82</sup>

The scientific controversy raises a host of larger questions about methodological and value choices in conditions of scientific uncertainty. For instance, most scientists consider DU's most serious risk to come from heavy metal toxicity,<sup>83</sup> whereas environmental advocates and the public focus on DU's radioactivity.<sup>84</sup> Should policymakers account for

<sup>73</sup> Physicians for Social Responsibility, *supra* note 32.

<sup>74</sup> For instance, the Department of Veteran Affairs studied only a tiny fraction of the veterans exposed to DU in the first Gulf War and, more troublingly, has been charged with distorting evidence of cancer among the participants. Fahey, *supra* note 27, at 27.

<sup>75</sup> PETER PHILIPS & PROJECT CENSORED, CENSORED 2005: THE TOP 25 CENSORED STORIES 147 (2005); Daniel Robicheau, *The Next Testing Site for Depleted Uranium Weaponry in DEPLETED URANIUM: A POSTWAR DISASTER FOR ENVIRONMENT AND HEALTH* (1999), <http://www.ratical.org/radiation/dhap/index.html>.

<sup>76</sup> Bertell, *supra* note 48.

<sup>77</sup> Robert M. Bowman, *Depleted Uranium and Birth Defects*, ALTERNATIVES, Winter 2004-2005, available at <http://www.alternativemagazine.com/32/bowman.html>.

<sup>78</sup> Moreover, DUWs are not precision-guided munitions. Over 80% of DUWs used in past conflicts have missed their targets. Fahey, *supra* note 25, ¶ 4.3.

<sup>79</sup> Ed Ward, *The Agent Orange of Eternity*, SCOOP, Sept. 27, 2004, available at <http://www.scoop.co.nz/stories/HL0409/S00261.htm>.

<sup>80</sup> Fahey, *supra* note 68, at 6-8.

<sup>81</sup> Fahey, *supra* note 25, ¶ 3.3. For instance, some activists claim that DU use has been massively underestimated since the government secretly uses DU penetrators in bunker busters. *Id.* ¶ 4.2.

<sup>82</sup> See generally METAL OF DISHONOR, *supra* note 27 (opposing DUWs through use of anecdotal evidence and unrigorous studies).

<sup>83</sup> WORLD HEALTH ORG., DEPLETED URANIUM (January 2003), available at <http://www.who.int/mediacentre/factsheets/fs257/en/>.

<sup>84</sup> See, e.g., Justo Bautista, *Cold War Service Earned Them Cancer*, N.J. RECORD, August 23, 2004, at B, available at 2004 WLNR 15236846 (discussing radiation-related illnesses, but not chemical toxicity, caused by DUWs); Rae Voegler, Editorial, *Tell Kerry, Bush To Get Rid of*



the public's concern about risks that scientists think are negligible? DU regulation also raises other tensions in the larger debate between scientists and the public — science alone cannot resolve implicit value choices.<sup>85</sup> To take one example, scientists focus on mortality as the major relevant consequence of a given risk. Studies, however, suggest the public has other more dominant concerns, such as whether the risk is voluntarily undertaken, especially dreaded, catastrophic in nature, equitably distributed, and a threat to future generations.<sup>86</sup> Knowledge about how many people could die as the result of DUWs fails to really address any of these public concerns. Existing international law provides some limited answers to these questions, but military precautionary principle advocates suggest that a new paradigm is needed.

#### *D. Application of the Precautionary Principle to DUWs*

Given the current uncertainties discussed above, many DUWs opponents and some legal scholars have argued that the precautionary principle should be applied to the use of DUWs. For example, Dr. Rosalie Bertell argues: "[t]he Precautionary Principle should dictate an even faster response: an immediate stoppage of the use of DU and care for the detoxification of veterans and civilians suspected of having exposure."<sup>87</sup> Similarly, one legal scholar contends: "[a]s for DU itself, work remains to be done to reach definitive scientific conclusion as to its effects. . . . In the meantime, pragmatism and conscience should provide strong arguments to preclude further use of these munitions; arguments which . . . are entrenched in binding international law."<sup>88</sup>

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*Nukes*, CAPITAL TIMES, Aug. 6, 2004, at 10A, available at 2004 WLNR 3664320; Anonymous, *We Wouldn't Want to Worry You; Activists Say Depleted Uranium Should No Longer Be Exempt from "Radioactive" Labeling*, METROLAND, July 29, 2004, at 16, available at 2004 WLNR 15267452.

<sup>85</sup> In addition, models used in risk assessment inherently rely on policy presumptions to bridge informational gaps. JOEL TICKNER ET AL., *THE PRECAUTIONARY PRINCIPLE IN ACTION: A HANDBOOK* 12 (1999), available at <http://www.biotech-info.net/handbook.pdf>.

<sup>86</sup> Paul Slovic et al., *Perceived Risk: Psychological Factors and Social Implications*, 376 PROC. ROYAL SOC'Y LONDON 17, 24 (Apr. 30, 1981).

<sup>87</sup> Bertell, *supra* note 48.

<sup>88</sup> Beckett, *supra* note 71, at 85; see also Myers, *supra* note 22; Avril McDonald, Background Paper for Presentation on "The International Legal Ramifications of the Use of DU Weapons," Symposium on the Health Impact of Depleted Uranium Munitions, ¶ 3.2 (June 14, 2003), available at [http://www.nuclearpolicy.org/files/nuclear/mcdonald\\_jun\\_14\\_03.pdf](http://www.nuclearpolicy.org/files/nuclear/mcdonald_jun_14_03.pdf); Campaign Against Depleted Uranium, *The Royal Society — A Royal Whitewash* (2001),

Because the precautionary principle lacks a fixed definition, this section disaggregates its various components and explains the arguments why DUWs might satisfy each component. The first component is the threshold level of harm required to trigger the precautionary principle. This level of harm ranges from "serious or irreversible damage," to "significant health or environmental damage," to "non-negligible harm," to a "threat of harm." DUWs clearly satisfy the lowest threshold, as the "threat of harm" seems only to mean that some scientists can agree that some risk exists. As for "significant" or "non-negligible" health or environmental damage, DUWs arguably satisfy this threshold as well. Both radioactivity and chemical toxicity from DUWs persist in the environment. If one takes seriously the claims that DU causes Gulf War Syndrome, a massive increase in the cancer rate, and/or widespread birth defects, then DUWs satisfy even the highest harm threshold of "serious or irreversible damage."

The second component is the degree of scientific uncertainty required to satisfy the precautionary principle. This value ranges from "uncertainty about damage or likelihood of risk," to "cause and effect not established fully," to "lack of full certainty." Enough scientific dispute exists to satisfy the "uncertainty about damage or likelihood of risk" criterion. On the other hand, "lack of full certainty" suggests that agreement is forming in favor of a given cause and effect relationship, but more work needs to be done before the scientific community is unified. The current controversy around DU does not seem to suggest such an emerging consensus. Ultimately, as no clear definition of the precautionary principle exists, it is very difficult to know when these benchmarks are met.

Once the threshold of harm and degree of scientific uncertainty are satisfied, the precautionary principle calls for a shift in the burden of proof, followed by some response by the proponent of the activity. Virtually all variants of the precautionary principle place the burden of proof on the proponent of the activity to demonstrate the safety of the questioned activity.<sup>89</sup> This makes some intuitive sense, as the proponent

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[http://www.cadu.org.uk/info/health/8\\_1.htm](http://www.cadu.org.uk/info/health/8_1.htm) ("[W]e believe that the [government] should apply the precautionary principle and stop the use of Depleted Uranium weapons until they can prove that it is not a weapon of indiscriminate destruction.").

<sup>89</sup> Alyn Ware, *Depleted Uranium Weapons and International Law*, in *METAL OF DISHONOR*, *supra* note 27, at 195, 201 (suggesting that "the precautionary principle . . . could apply to DU weapons. The precautionary principle . . . provides that when there is reason to believe that a particular practice could generate transborder environmental damage, the onus is on

is often in the best position to produce information on the safety of the regulated activity. In the case of DU, this is certainly true. Although NGOs are conducting some preliminary studies, the military has the best and often the only information on where DU has been deployed and who has been exposed to it. Similarly, the companies contracted to make DU armor and DUWs have superior information about the health and environmental problems of workers exposed to DU when producing ammunition and armored tanks.

Finally, the outcomes dictated by the precautionary principle range from greater research to establish the cause and effect relationship between the activity and the harm, to “cost effective measures to prevent the harm,” to a ban or moratorium on the activity along with a dictate to clean up the harm and care for those already affected by the activity. The weakest version of the precautionary principle serves as a call for action in the form of more scientific research about the harms of DUWs. Such a demand for greater study is relatively uncontroversial. It is more challenging to determine what the cost conscious versions of the precautionary principle require, because such requirements depend on whether “cost” includes military costs or just the financial cost of securing a replacement weapon system. A serious cost-conscious version, therefore, militates in favor of educational campaigns for affected civilian and military populations but away from full remediation.<sup>90</sup> A still stronger version dictates a ban on DUWs until proponents can prove their safety. It also directs the United States to devote resources to remediating contaminated sites here and abroad.

## II. LEGAL BACKGROUND OF WEAPONS REGULATION

The laws of war provide limits, including a few per se bans, on weapon systems based on their effects. Despite these constraints, international law offers little direct guidance on the appropriate action to take when no consensus exists on a weapon’s health and environmental effects. Rather than address individual weapons on a case-by-case basis,

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the practicing party to prove its safety.”).

<sup>90</sup> Another possible option is to provide protective gear to military personnel. The use of protective gear on-balance increases risks to military personnel. Although the long-term effects of DU present only a small increase in the risk of cancer or kidney failure, protective gear presents immediate risks by “increasing the risk of heat related injuries and reduces the Soldier’s effectiveness in safely performing the job.” U.S. ARMY CTR. FOR HEALTH PROMOTION & PREVENTIVE MED. & THE U.S. ARMY HEAVY METALS OFFICE, *supra* note 70, at xv.

most laws of war set a baseline of unsurpassable harm. For the use of those weapons that fall below the baseline, international law codifies the relevant factors to be considered in determining whether their use is permissible. Yet the guidelines do not tell the international community much about what type of proof triggers these protections.

This section explores the application of international law requirements to DUWs. It also responds to the frequent claims that the use of DUWs violates existing international law.<sup>91</sup> In so doing, it explores the tension between the United States and other states about how to interpret relevant international law. For instance, the precautionary principle, potentially part of customary international law, provides one approach to coping with situations of uncertainty, but much debate exists over the status, content, and scope of this principle. This section then briefly surveys foreign and domestic restrictions on DUWs to provide some perspective on the regulatory puzzle faced by the United States.

#### A. *International Law*

Under the laws of war, states may employ any weapon unless that weapon's use violates a treaty or customary international law.<sup>92</sup> Three principles — military necessity, humanity, and chivalry<sup>93</sup> — undergird

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<sup>91</sup> H.R. 1483, 108th Cong. § 11 (2003) ("The 1949 Geneva Convention specifically outlines the precautions warring nations must take to avoid harming civilian populations, and it would be a violation of the 1977 Protocol to that Convention to cause superfluous injury or unnecessary suffering to civilians, as depleted uranium may cause."); Clark, *supra* note 54, at 22 (claiming DUWs possess "inherent cruelty and unconfined death-dealing effect"); David M. Boje, *Sanctions: U.S. Violations of the Geneva Convention* (Feb. 27, 2003), <http://peaceaware.com/documents/Sanctions%20Against%20Geneva%20Convention.htm> ("The aggression against Iraq during the Gulf War with Enriched Uranium weapons and debris strewn along the infamous 'Highway of Death' did exactly this, making that weapon deployment illegal under international law."); Conn Hallinan, *Aftermath: Cleaning Up the Mess*, FOREIGN POL'Y FOCUS, 2003, <http://www.fpif.org/commentary/2003/0304aftermath.html> ("[Depleted Uranium] is, however, illegal. In August of last year, a United Nations subcommittee found that the use of DU violated seven international agreements including the UN Charter and the Geneva Conventions.").

Convention.htm ("The aggression against Iraq during the Gulf War with Enriched Uranium weapons and debris strewn along the infamous 'Highway of Death' did exactly this, making that weapon deployment illegal under international law."); Conn Hallinan, *Aftermath: Cleaning Up the Mess*, FOREIGN POL'Y FOCUS, 2003, <http://www.fpif.org/commentary/2003/0304aftermath.html> ("[Depleted Uranium] is, however, illegal. In August of last year, a United Nations subcommittee found that the use of DU violated seven international agreements including the UN Charter and the Geneva Conventions.").

<sup>92</sup> *Military and Paramilitary Activities in and Against Nicaragua* (Nicar. v. U.S.), 1986 I.C.J. 14 (June 27) ("in international law there are no rules, other than such rules as may be accepted by the State concerned, by treaty or otherwise, whereby the level of armaments of a sovereign State can be limited"); *Legality of the Threat or Use of Nuclear Weapons*, 1996 I.C.J. Acts & Docs. 265 ("State practice shows that the illegality of the use of certain weapons as such does not result from an absence of authorization, but, on the contrary, is formulated in terms of prohibition.").

<sup>93</sup> Although not directly relevant to this paper, chivalry precludes dishonorable methods and means of warfare. ADAM ROBERTS & RICHARD GUELFF, DOCUMENTS ON THE

the laws of war.<sup>94</sup> In brief, military necessity directs that “only that degree and kind of force . . . required for the . . . submission of the enemy with a minimum expenditure of time, life, and physical resources may be applied.”<sup>95</sup> Humanity prohibits all force not authorized by military necessity.<sup>96</sup> So, to take an easy case, one side may not use a campaign of sustained bombing to get the enemy to submit when a single bomb would clearly produce the same result. In turn, these principles encompass the concept of discrimination, which dictates that warfare must be conducted in a manner that respects the greater protections afforded to civilians.<sup>97</sup> Similarly, the concept of proportionality directs military planners to avoid manifestly disproportionate damage to civilians even under conditions of military necessity.<sup>98</sup> These principles and concepts guide the determination of a weapon’s lawfulness under the particular laws of war.<sup>99</sup> This section applies these laws of war principles to DUWs within the context of relevant treaties and customary international law.

### 1. Treaty Law

Treaty law provides numerous limits on the means and methods of warfare. This section looks at the St. Petersburg Declaration, the Hague Convention, and Protocol I to the Geneva Convention, as well as particular weapons bans, for guidance on the legality of DUWs. In particular, the section focuses on the relevant treaty language and identifies areas of potential dispute. It also highlights the limitations of international law in dealing with the uncertainty of unintended secondary effects of weapons. In order to provide a brief overview of the discussion, the following chart may prove helpful:

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LAWS OF WAR 10 (Adam Roberts & Richard Guelff eds., 2000).

<sup>94</sup> *Id.*

<sup>95</sup> *Id.* (citing U.S. DEP’T OF NAVY, THE COMMANDER’S HANDBOOK ON THE LAW OF NAVAL OPERATIONS, NWP 1-14M, 5-1 (1995)).

<sup>96</sup> *Id.*

<sup>97</sup> *Id.* at 9-10.

<sup>98</sup> Walter Gary Sharp, Sr., *American Hegemony and International Law: The Use of Armed Force Against Terrorism: American Hegemony or Impotence?*, 1 CHI. J. INT’L L. 37, 43 (2000).

<sup>99</sup> It has also been suggested that the principles of neutrality and intergenerational equity are principles of customary international law that are particularly relevant to the commission of environmental harm in warfare. Richard Falk, *The Environmental Law of War: An Introduction*, in ENVIRONMENTAL PROTECTION AND THE LAW OF WAR 78, 85 (Glen Plant ed., 1992).

International Law	Relevant Provision	Does It Outlaw DUWs?	Does the United States Consider It Binding?
St. Petersburg Declaration	Only legitimate object of warfare is to weaken military forces	No	Yes
Hague Convention	<p>1. <b>Martens clause:</b> states remain under the protection and rule of the principles of the laws of nations, established by civilized persons from the laws of humanity and the dictates of public conscience</p> <p><i>Interpretation 1:</i> this clause helps interpret existing international law</p> <p><i>Interpretation 2:</i> this clause is an independent source of law</p>	<p>No</p> <p>Maybe</p>	<p>Yes</p> <p>No</p>

	2. <b>Article 23:</b> ban on poison weapons and those arms calculated to cause unnecessary suffering	No	Yes
Protocol I to Geneva Convention	1. <b>Article 35(3):</b> ban on means and methods which are intended or may be expected to cause widespread, long-term, and severe damage	Probably not	No
	2. <b>Article 55(1):</b> prohibition on means and methods which are intended or may be expected to cause such damage to the natural environment and thereby to prejudice the health or survival of a population	No	No
	3. <b>Articles 48-51:</b> prohibition on indiscriminate attacks	Probably not	Yes
	4. <b>Article 36:</b> determines if weapon complies with international law <i>Interpretation 1:</i> this article includes the precautionary principle	Maybe	No
	<i>Interpretation 2:</i> this article does not include the precautionary principle	No	Yes
Chemical Weapons Convention	Ban on weapons designed to cause death or damage by their toxic properties	No	Yes
Biological Weapons Convention	Ban on toxins of types and in quantities that have no justification for prophylactic, protective, or other purposes	No	Yes

a. St. Petersburg Declaration

The St. Petersburg Declaration of 1868 states: “[t]he only legitimate object which states should endeavor to accomplish during war is to weaken the military forces of the enemy.”<sup>100</sup> As this principle is now part of customary international law,<sup>101</sup> it governs all states that do not consistently and unequivocally reject this principle,<sup>102</sup> including the United States. The St. Petersburg Declaration restricts those actions and weapons designed to target human health or the environment as an end in itself. It fails to speak to those instances in which a weapon’s potential impact on the natural environment and civilians is an unintended result rather than a military objective. As currently used, DUWs satisfy the “legitimate object” requirement — they weaken the enemy’s military forces by impeding their use of tanks.

b. The Hague Convention

Like the St. Petersburg Declaration, Hague law governs the means and methods of warfare.<sup>103</sup> The 1907 Hague Convention contains the Martens clause, which declares:

[u]ntil a more complete code of laws of wars has been issued . . . in cases not included in the Regulations adopted by [the High Contracting Parties], the inhabitants and the belligerents remain under the protection and the rule of the principles of the laws of nations, established among civilized peoples, from the laws of humanity and the dictates of public conscience.<sup>104</sup>

The United States has ratified the 1907 Hague Convention and recognizes its dictates as declaratory of customary international law.<sup>105</sup>

No international consensus exists as to the clause’s meaning. Existing

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<sup>100</sup> Declaration Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight, Dec. 11, 1868, 138 Consol. T.S. 297, *reprinted in* 1 AM. J. INT’L L. 95 (Supp. 1907) [hereinafter the St. Petersburg Declaration].

<sup>101</sup> Anthony Leibler, *Deliberate Wartime Environmental Damage: New Challenges for International Law*, 23 CAL. W. INT’L L.J. 67, 101 (1992).

<sup>102</sup> ROBERTS & GUELF, *supra* note 93, at 7.

<sup>103</sup> Convention Respecting the Laws and Customs of War on Land, Oct. 18, 1907, 205 Consol. T.S. 277 [hereinafter Hague Convention].

<sup>104</sup> The Martens clause originally appeared in the 1899 Final Act of the Hague Peace Conference. Final Act of the International Peace Conference, July 27, 1899, 26 Martens Nouveau Recueil (ser. 2) 258.

<sup>105</sup> ROBERTS & GUELF, *supra* note 93, at 69.



scholarship yields three plausible interpretations: (1) the clause only assists in interpreting existing international principles and rules, (2) the clause recognizes the laws of humanity and the dictates of public conscience as independent sources of international law, or (3) the clause expresses “notions that motivated and inspired the development of international humanitarian law.”<sup>106</sup> Notably, the United States views the Martens clause as a clarification that customary international law governs those cases not explicitly addressed by the Hague Convention.<sup>107</sup> Under such a view, the Martens clause alone can never provide sufficient support to outlaw the use of a particular weapon.<sup>108</sup> Empirical practice seems to favor this view — no domestic or international court has fleshed out the scope of these dictates as independent sources of law, and the Martens clause has never been successfully invoked to preclude the use of a new weapon.

Under the most expansive view, however, the Martens clause recognizes the laws of humanity and the dictates of public conscience as independent sources of international law. In recent years, proponents of this view generally agree that the Martens clause precludes “unjustifiable damage to the environment.”<sup>109</sup> If DUWs cause the type of environmental damage that their opponents describe, it is reasonable to consider that unjustifiable damage. The Martens clause, however, does not directly speak to circumstances of uncertainty about whether a weapon will cause unjustifiable damage.<sup>110</sup> Without some outside

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<sup>106</sup> Antonio Cassese, *The Martens Clause: Half a Loaf or Simply Pie in the Sky*, 11 EUR. J. INT’L L. 187, 188-92 (2000). Similarly article 38(1) of the International Court of Justice Statute includes “general principles of law recognized by civilized nations.” Statute of the International Court of Justice, art. 38(1), June 26, 1945, 59 Stat 1031, 1061. In this context, this clause has “no clearly established meaning” nor does it obviously include the precautionary principle. TROUWBORST, *supra* note 13, at 44-46.

<sup>107</sup> Legality of the Use by a State of Nuclear Weapons in Armed Conflict and Legality of the Threat or Use of Nuclear Weapons, I.C.J. Doc. CR 95/34 78 (Req. for Advisory Op.) (Public mtg. on Nov. 15, 1995), available at [http://www.icj-cij.org/icjwww/icasess/iunan/iunan\\_cr/iUNAN\\_iCR9534\\_19951115.PDF](http://www.icj-cij.org/icjwww/icasess/iunan/iunan_cr/iUNAN_iCR9534_19951115.PDF).

<sup>108</sup> The proponents of this view believe a shared sentiment does not legitimate the expansion of existing treaties to forbid particular weapons beyond the scope of the treaty’s text. See Michael Bothe, *The Protection of the Environment in Times of Armed Conflict: Legal Rules, Uncertainty, Deficiencies and Possible Developments*, 34 F.R.G. Y.B. INT’L L. 54, 56-58 (1991).

<sup>109</sup> Glen Plant, *Introduction*, in ENVIRONMENTAL PROTECTION AND THE LAW OF WAR, *supra* note 99, at 3, 17.

<sup>110</sup> Michael N. Schmitt, *War and the Environment: Fault Lines in the Prescriptive Landscape*, in THE ENVIRONMENTAL CONSEQUENCES OF WAR: LEGAL, ECONOMIC AND SCIENTIFIC PERSPECTIVES 87, 126-27 (Jay E. Austin & Carl E. Bruch eds., 2000) [hereinafter

guiding principle as to how to act under conditions of uncertainty, the Martens clause probably should not be read to forbid the use of DUWs.<sup>111</sup>

c. The Geneva Convention

Geneva law also provides some relevant limitations on the use of weapons. The 1977 Protocol I to the Geneva Convention created new protections for civilians and the environment during international armed conflicts, as well as expanded some existing principles of customary international law.<sup>112</sup> The United States never ratified Protocol I<sup>113</sup> and does not consider its environmental provisions to be customary law.<sup>114</sup>

Article 35(3) of Protocol I prohibits "means and methods of warfare which are intended, or may be expected, to cause widespread, long-term and severe damage to the natural environment."<sup>115</sup> In turn, the Rome Statute of the International Criminal Court criminalizes "widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated."<sup>116</sup> Each of the three conditions of article 35(3) — widespread, long-term, and severe damage — must be separately satisfied. In the United Nations Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification

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ENVIRONMENTAL CONSEQUENCES OF WAR] (describing terms of Martens clause as "both vague and ambiguous. In fact, history demonstrated that exhortatory calls on the conscience of mankind all too often fall on deaf ears."). *But see* Richard A. Falk, *Environmental Disruption by Military Means and International Law*, in ENVIRONMENTAL WARFARE: A TECHNICAL, LEGAL, AND POLICY APPRAISAL 33, 41 (Arthur H. Westing ed., 1984) (arguing that it is "a fair reading" to argue that Martens clause prohibits wide range of radiological weapons).

<sup>111</sup> McDonald, *supra* note 88, ¶ 2.1.3.

<sup>112</sup> 1977 Geneva Protocol I Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts, *opened for signature* Dec. 12 1977, 1125 U.N.T.S. 3 [hereinafter Protocol I].

<sup>113</sup> George H. Aldrich, *Prospects for United States Ratification of Additional Protocol I to the 1949 Conventions*, 85 AM. J. INT'L L. 1, 3 (1991).

<sup>114</sup> Falk, *supra* note 110, at 39; Dieter Fleck, *Protection of the Environment During Armed Conflict and Other Military Operations: The Way Ahead*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT, *supra* note 22, at 529, 533; John H. McNeill, *Protection of the Environment in Time of Armed Conflict: Environmental Protection in Military Practice*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT, *supra* note 22, at 537, 541; Plant, *supra* note 109, at 16.

<sup>115</sup> Protocol I, *supra* note 112, art. 35(3).

<sup>116</sup> Rome Statute of the International Criminal Court, July 17, 1998, art. 8(2)(b)(iv), U.N. Doc. A/Conf.183/9 (2002), available at <http://www.un.org/law/icc/statute/rome.htm>.

Technique (“ENMOD”),<sup>117</sup> “widespread” was taken to mean at least “several hundred kilometers.”<sup>118</sup> States negotiating Protocol I, however, specifically rejected the use of ENMOD’s definitions for article 35.<sup>119</sup> Ultimately, the widespread effects debate turns on the amount of DUWs used in a given conflict and the ability of DU dust to travel through the air, water, and soil. The next condition, “long-term,” implies at least a matter of decades.<sup>120</sup> As DUWs take several hundred years to fully corrode into the environment,<sup>121</sup> they clearly satisfy this requirement. Finally, the term “severe” sets a vague threshold somewhere above significant harm.<sup>122</sup> Some dispute exists as to whether “severe” only refers to the damage to the environment, as indicated by the plain text of the Protocol, or whether it also requires an evaluation of the environmental damage on actual or potential human populations.<sup>123</sup> It is difficult to suggest much that meets article 35(3), given that scholars were unable to agree if even the Iraqi oil fires satisfied this standard.<sup>124</sup>

Scholars and lawyers agree that article 35(3) sets a very high standard.<sup>125</sup> Treaty makers were wary of prohibiting anything short of the worst environmental consequences for both pragmatic and utilitarian justifications — the precautionary principle was not dominant when Protocol I was drafted.<sup>126</sup> Commentators to article 35 contemplated that it would outlaw only a “serious disruption of the natural equilibrium permitting life and the development of man and all living organisms.”<sup>127</sup> Some anti-DU activists suggest that DU’s harms extend this far, but no

<sup>117</sup> United Nations Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, Dec. 10, 1976, T.I.A.S. 9614 [hereinafter ENMOD].

<sup>118</sup> ROBERTS & GUELF, *supra* note 93, at 407. Using several hundred kilometers as a minimum baseline, one scholar suggests that the combination of all DU attacks in Kosovo would satisfy such a requirement. HULME, *supra* note 49, at 238.

<sup>119</sup> ROBERTS AND GUELF, *supra* note 93, at 408.

<sup>120</sup> COMMENTARY ON THE ADDITIONAL PROTOCOLS OF 8 JUNE 1977 TO THE GENEVA CONVENTIONS OF 12 AUGUST 1949, AND RELATING TO THE PROTECTION OF VICTIMS OF INTERNATIONAL ARMED CONFLICT (PROTOCOL I) para. 1452 (Yves Sandoz et al. eds., 1987), <http://www.icrc.org/ihl.nsf/CONVPRES?OpenView> [hereinafter COMMENTARY ON PROTOCOL I].

<sup>121</sup> HULME, *supra* note 49, at 238.

<sup>122</sup> *Id.* at 96.

<sup>123</sup> *Id.*

<sup>124</sup> Eric Talbot Jensen & James J. Texeira, Jr., *Prosecuting Members of the U.S. Military for Wartime Environmental Crimes*, 17 GEO. INT’L ENVTL. L. REV. 651, 662 (2005).

<sup>125</sup> COMMENTARY ON PROTOCOL I, *supra* note 120, at para. 1458.

<sup>126</sup> Bothe, *supra* note 108, at 57-58.

<sup>127</sup> COMMENTARY ON PROTOCOL I, *supra* note 120, at para. 1462.

consensus exists within the movement to ban DU and most governments do not think DUWs create such serious damage.<sup>128</sup> Moreover, article 35(3) is silent about situations of uncertainty. Protocol I dictates no method or standards to determine when a weapon is likely to cause widespread, long-term, and severe damage to the environment.

Similarly, article 55(1) provides that:

[c]are shall be taken in warfare to protect the natural environment against widespread, long-term and severe damage. This protection includes a prohibition of the use of methods or means of warfare which are intended or may be expected to cause such damage to the natural environment and thereby to prejudice the health or survival of the population.<sup>129</sup>

Article 55(1)'s prohibition only extends to extreme environmental damage,<sup>130</sup> but the duty to "take care" requires states to take reasonable steps to protect the environment in all wartime circumstances.<sup>131</sup> Such a duty might incorporate the precautionary principle, in its least aggressive forms, by requiring some form of environmental impact assessment.<sup>132</sup>

Protocol I also contains several provisions that are relevant to the consequences of conflict on civilian health. Protocol I helps flesh out the principle of civilian discrimination. Article 48 dictates that "parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives."<sup>133</sup> Article 51 prohibits indiscriminate attacks, including those "which employ a method or means of combat[,] the effects [of] which cannot be limited as required by this Protocol; and consequently, in each such case, are of a nature to strike military objectives and civilians or civilian objectives without distinction."<sup>134</sup> An example given in article 51(5)(b) illuminates this prohibition in stating that an indiscriminate

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<sup>128</sup> See *supra* Part I.B.

<sup>129</sup> ROBERTS & GUELF, *supra* note 93, at 451.

<sup>130</sup> See generally Robert M. Augst, *Environmental Damage Resulting from Operation Enduring Freedom: Violations of International Law*, 33 ENVTL. L. REP. NEWS & ANALYSIS 10668 (Sept. 2003) (supporting argument that "intended or expected to" prong would not include the use of DU).

<sup>131</sup> HULME, *supra* note 49, at 81.

<sup>132</sup> *Id.* at 85-86.

<sup>133</sup> Protocol I, *supra* note 112, art. 48.

<sup>134</sup> *Id.* art. 51(4)(c).

attack includes “an attack which may be expected to cause incidental loss of civilian life, injury to civilians, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.”

Article 51 thus provides some ground for DU opponents. A dissenting judge in the International Court of Justice case *Yugoslavia v. Belgium* suggested that DUWs’ “effects have no limitation either in space or in time,”<sup>135</sup> which would seem to fall under article 51’s prohibition against indiscriminate attacks. As explained above, even if DUWs are targeted at a military objective, some evidence suggests that DUWs can cause long-term damage to the environment and civilians. Yet article 51’s prohibition only extends to “conduct that directly and indiscriminately affects both military and civilians, rather than conduct that might affect civilians indirectly and as a secondary effect.”<sup>136</sup> Also, article 51(5)(b) demonstrates that the determination of an attack’s indiscriminateness hinges on the military utility debate. The evaluation of the military utility debate requires a hard look at the available alternatives to DUWs. In addition, the Convention on Conventional Weapons,<sup>137</sup> which adopted Protocol I’s definition of “indiscriminate attacks,” only limited but did not prohibit the use of landmines, which have a much more certain effect on civilian populations.<sup>138</sup>

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<sup>135</sup> 1999 I.C.J. 124, 224 (June 2) (Kreca, J., dissenting). The International Court of Justice (“ICJ”) declined to reach the merits of several cases challenging the use of depleted uranium in Yugoslavia. *See generally* *Yugoslavia v. Belgium*, 1999 I.C.J. 124 (June 2). One dissenting judge suggested that the inability to cabin DUWs’ effects meant the ICJ possessed equitable grounds to hear the cases. *Id.* at 183-85 (Weeramantry, V-P, dissenting).

<sup>136</sup> McDonald, *supra* note 88, ¶ 2.1.3.1.

<sup>137</sup> Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices (Protocol II) art. 3, para. 3, Apr. 10, 1981, 1342 U.N.T.S. 128.

<sup>138</sup> *Id.*

The indiscriminate use of weapons to which this Article applies is prohibited. Indiscriminate use is any placement of such weapons: (a) which is not on, or directed at, a military objective, (b) which employs a method or means of delivery which cannot be directed at a specific military objective, or (c) 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.

*Id.*

d. Specific Weapons Regulations

International law also contains a number of specific weapons bans. Most weapon bans focus on the primary effect of the weapon rather than its secondary or incidental effects. For instance, article 23 of the Hague convention forbids the use of "poison weapons" and "arms, projectiles, or material calculated to cause unnecessary suffering."<sup>139</sup> To qualify as a poison weapon, the "prime, or even exclusive, effect" must be to poison.<sup>140</sup> Although DUWs are inherently poisonous, military planners did not design DUWs with the "specific intention" to poison.<sup>141</sup> For similar reasons, the Chemical Weapons Convention does not govern DUWs.<sup>142</sup> DUWs also fall outside the reach of the Biological Weapons Convention, which limits its scope to toxins "of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes."<sup>143</sup> Finally, the Conventional Weapons Convention excludes "munitions in which the incendiary effect is not specifically designed to cause burn injury to persons, but to be used against military objectives, such as armoured vehicles, aircraft and installations or facilities."<sup>144</sup> Thus, no specific weapon prohibitions specifically govern DUWs.

e. Domestic View of DUWs' Compliance with International Law

Under article 36 of Protocol I, state parties must determine whether the use of a new weapon would be banned under the Protocol or international law more generally.<sup>145</sup> States have interpreted "new" to

<sup>139</sup> Hague Convention, *supra* note 103, art 23. No weapon has ever been discarded solely under the suffering calculus. FRITS KALSHOVEN & LIESBETH ZEGVELD, CONSTRAINTS ON THE WAGING OF WAR: AN INTRODUCTION TO INTERNATIONAL HUMANITARIAN LAW 41-42 (3d ed. 2001), available at [http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/p0793/\\$File/ICRC\\_002\\_0793.PDF](http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/p0793/$File/ICRC_002_0793.PDF)! Open.

<sup>140</sup> Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. 8, at para. 55. (July 8).

<sup>141</sup> McDonald, *supra* note 88, ¶ 3.1.4.1.1.

<sup>142</sup> Chemical weapons must be specifically designed to cause death or damage by their toxic properties. Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction art. II(1)(6), Jan. 13, 1993, 32 I.L.M. 800 (entered into force April 29, 1997).

<sup>143</sup> Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction art. I(1), Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 163.

<sup>144</sup> Protocol on Prohibitions or Restrictions on Use of Incendiary Weapons (Protocol III) art. 1(1)(b), Oct. 10, 1980, 1342 U.N.T.S. 171, 172.

<sup>145</sup> Art. 36 of Protocol I dictates that "in the study, development, acquisition or adoption

mean that the obligation to test applies at the research and development stage rather than when a weapon is new to an acquiring state.<sup>146</sup> Article 36 allows states to devise their own methods to test compliance. No guidelines or commentary suggest the types of studies that should be conducted nor dictate any uniform scientific protocols or presumptions. The United States has not ratified Protocol I,<sup>147</sup> but it seemingly recognizes this provision as a codification of customary international law.<sup>148</sup>

As required by international and domestic law, the United States conducted two legal reviews of DU munitions.<sup>149</sup> These weapons reviews were designed to ensure that the Department of Defense ("DOD") observed and enforced the United States's laws of war obligations.<sup>150</sup> Under such a review, the military analyzed the weapons' (1) mission and military advantage, (2) medical, scientific, and environmental effects, and (3) legality under relevant international law restrictions.<sup>151</sup>

The first review, conducted in 1975, found that DU penetrators, as then used, did not violate international law prohibitions against unnecessary suffering or indiscriminate effects.<sup>152</sup> The second review, conducted in 1994, included compliance questions under articles 35 and 55 of Protocol I.<sup>153</sup> This review concluded that DU rounds were permissible as they were not more chemically toxic than lead.<sup>154</sup>

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of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party." Protocol I, *supra* note 112, art. 36.

<sup>146</sup> Cf. COMMENTARY ON THE ADDITIONAL PROTOCOLS OF 8 JUNE 1977 TO THE GENEVA CONVENTIONS OF 12 AUGUST 1949, at paras. 1466, 1472 (Yves Sandoz et al. eds., 1987) (explaining that determination of legality is made when weapon is new and that "it cannot be expected that States will introduce specific prohibitions on the basis of general principles, when such prohibitions could be considered as an a posteriori condemnation of the prior use of such weapons.").

<sup>147</sup> ROBERTS & GUELFF, *supra* note 93, at 497.

<sup>148</sup> See Falk, *supra* note 110, at 39.

<sup>149</sup> McDonald, *supra* note 88, ¶¶ 3.1.4.1.1-3.1.4.1.2.

<sup>150</sup> DEP'T OF DEF., DIRECTIVE 5100.77, DOD LAW OF WAR PROGRAM para. 4.1 (Dec. 9, 1998).

<sup>151</sup> For a more thorough discussion of this review process, see Major Donna Marie Verchio, *Just Say No! The SIRUS Project: Well Intentioned, but Unnecessary and Superfluous*, 51 A.F. L. REV. 183, 219 (2001).

<sup>152</sup> McDonald, *supra* note 88, ¶ 3.1.4.1.1.

<sup>153</sup> *Id.* ¶ 3.1.4.1.2.2.

<sup>154</sup> *Id.*

The DOD's 1994 DU review is unsatisfying for a few reasons. The DOD adopted a controversial threshold standard for evaluating safe exposure to DU,<sup>155</sup> using five rems a year.<sup>156</sup> This threshold is based on the National Council on Radiation Protection ("NCRP") standard, which allows five rems per year for workers in radioactive environments.<sup>157</sup> The DOD declined to adopt the much lower .1 rem per year, the standard which the NCRP recommends for members of the public. The DOD's adoption of the higher standard makes sense because the report only evaluated possible exposure levels for the military. The DOD failed, however, to discuss the possible exposure levels of civilians or cleanup crews.<sup>158</sup>

## 2. Customary International Law — The Precautionary Principle

Like treaty law, customary international law also restricts some weapon systems. The Third Restatement of International Law defines "customary international law" as "a general and consistent practice of states followed by them from a sense of legal obligation."<sup>159</sup> Thus, two components comprise customary international law: state practice and *opinio juris*. In order to qualify as state practice, states must satisfy duration, consistency, and generality requirements.<sup>160</sup>

Scholarly dispute exists as to whether the precautionary principle is already customary international law or merely an emerging principle.<sup>161</sup>

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<sup>155</sup> DEP'T OF DEF., OFFICE OF THE SPECIAL ASSISTANT FOR GULF WAR ILLNESSES, ENVIRONMENTAL EXPOSURE REPORT, DEPLETED URANIUM, A SHORT COURSE (July 31, 1998), available at <http://www.gulflink.osd.mil> [hereinafter SHORT COURSE]. See discussion in Jeremy Burton, Note, *Depleted Morality*, *Yugoslavia v. Ten Nato Members and Depleted Uranium*, 19 WIS. INT'L L.J. 17, 29-30 (2000).

<sup>156</sup> SHORT COURSE, *supra* note 155.

<sup>157</sup> *Id.* It is worth noting that domestic courts treat DU as if it has been clearly established as a carcinogen. *TNS, Inc. v. NLRB*, 296 F.3d 384, 387 (6th Cir. 2002); *Oil, Chem. & Atomic Workers Int'l Union v. NLRB*, 46 F.3d 82, 85 (D.C. Cir. 1995).

<sup>158</sup> The latest Army study of DU also focuses solely on the health risks to military personnel. U.S. ARMY CTR. FOR HEALTH PROMOTION AND PREVENTIVE MED. & THE U.S. ARMY HEAVY METALS OFFICE, *supra* note 70, at iii.

<sup>159</sup> RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 102(2) (1987).

<sup>160</sup> TROUWBORST, *supra* note 13, at 55.

<sup>161</sup> For views that the precautionary principle is customary international law, see HAROLD HOHMANN, PRECAUTIONARY LEGAL DUTIES AND PRINCIPLES OF MODERN INTERNATIONAL LAW 342-44 (1994), TROUWBORST, *supra* note 13, at 286, and Owen McIntyre & Thomas Mosedale, *The Precautionary Principle as a Norm of Customary International Law*, 9 J. ENVTL. L. 221, 221 (1997). For the opposing view, see Catherine Ticker, *State Responsibility and the Precautionary Principle*, in THE PRECAUTIONARY PRINCIPLE AND INTERNATIONAL LAW



While resolving this debate is outside this Article's scope, a basic understanding of the conflict is helpful. Some scholars have concluded that the combination of nearly uniform precautionary state practice and strong evidence of *opinio juris* requires states to comply with the precautionary principle.<sup>162</sup> Similarly, a few national courts in other countries have concluded that some formulation of the precautionary principle is customary international law.<sup>163</sup> On the other hand, the gap between international support for the principle and the limited domestic implementation of its dictates suggests insufficient state practice.<sup>164</sup> Of the international bodies presented with this question,<sup>165</sup> both the Appellate Body of the World Trade Organization and the International Court of Justice have each twice declined to address the question of whether the precautionary principle is a principle of customary international law.<sup>166</sup> Because the United States has frequently and publicly eschewed the precautionary principle as customary international law,<sup>167</sup> it may qualify as a persistent objector<sup>168</sup> not bound by

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53, 53 (David Freestone & Ellen Hey eds., 1996), and Richard B. Bilder & Sumudu Atapattu, *Evolution and Status of the Precautionary Principle in International Law*, 96 AM. J. INT'L L. 1016, 1017-18 (2002) (book review).

<sup>162</sup> See TROUWBORST, *supra* note 13, at 286.

<sup>163</sup> 114957 Canada Ltée v. Hudson, [2001] 2 S.C.R. 241, paras. 31-32 (Can.); A.P. Pollution Control Board v. Nayudu, 1 I.L.R. 185, para. 31 (India 1999).

<sup>164</sup> Bilder & Atapattu, *supra* note 161.

<sup>165</sup> See generally Sonia Boutillon, Note, *The Precautionary Principle: Development of an International Standard*, 23 MICH. J. INT'L L. 429 (2002).

<sup>166</sup> Gabcikovo-Nagymaros Project (Hung. v. Slov.), 1997 I.C.J. 7, 35-45 (Judgment of Sept. 25) (discussing "ecological necessity" and general benefits of prevention without explicitly acknowledging precautionary principle); Request for Examination of the Situation in Accordance with Paragraph 63 of the Court's Judgment of 20 December 1974 in the Nuclear Tests Case (N.Z. v. Fr.), 1995 I.C.J. 288, 306-08 (Order of Sept. 22) (dismissing nuclear testing case on procedural grounds), available at <http://www.icj-cij.org/icjwww/idecisions.htm> (select hyperlink to decision located under heading "Contentious Cases 2005"); Appellate Body Report, *Measures Affecting Agricultural Products*, ¶¶ 81-84, WT/DC76/AB/R (Feb. 22, 1999); Appellate Body Report, *Measures Concerning Meat and Meat Products (Hormones)*, ¶ 123, WT/DS26/AB/R (Jan. 16, 1998). In contrast, those cases decided by international tribunals where the precautionary principle was decisive were cases in which the parties made an agreement that specifically bound them to the precautionary principle. Southern Bluefin Tuna Cases (N.Z. v. Japan, Austl. v. Japan), ¶ 90, 117 I.L.R.148 (Int'l Trib. L. of the Sea 1999) (requesting Provisional Measures).

<sup>167</sup> *Measures Concerning Meat and Meat Products (Hormones)*, *supra* note 166, ¶¶ 43, 122; TROUWBORST, *supra* note 13, at 280 (discussing United States's objection to precautionary principle during Climate Change Convention negotiations).

<sup>168</sup> See Jutta Brunnee, *The United States and International Environmental Law: Living with an Elephant*, 15 EUR. J. INT'L L. 617, 629 (2004).

the principle's dictates.<sup>169</sup>

Even if the precautionary principle is customary international law, such a principle may not apply in wartime.<sup>170</sup> The debate over the precautionary principle fits into a much larger debate about whether and how to change international law to better regulate environmental damage in international armed conflict. On one side, scholars think that existing international law provides adequate protection for the environment. They want to focus intellectual and financial resources on increasing the number of countries that join the existing relevant treaties, promoting adherence to the relevant law during actual conflict, and creating more certain punishments for those that violate these prohibitions.<sup>171</sup> As the precautionary principle was certainly not customary international law when most laws of war were adopted, many in this camp contend that such a requirement ought not trump more specific treaty language dealing with the protection of the environment during conflict.<sup>172</sup> To these scholars, the process of

<sup>169</sup> As a persistent objector, a state is not bound by customary international law. ROBERTS & GUELFF, *supra* note 93, at 7. In order to qualify as a persistent objector, a state must possess clear evidence of its consistent refusal to accept a particular customary rule. TROUWBORST, *supra* note 13, at 50.

<sup>170</sup> See ANTOINE BOUVIER, INT'L COMM. RED CROSS, *Foreword to PROTECTION OF THE ENVIRONMENT IN TIME OF ARMED CONFLICT* (Nov. 17, 1993) (Submitted to the 48th Session of the U.N. General Assembly), available at <http://www.icrc.org/Web/Eng/siteeng0.nsf/html/5DEESV> (asking for clarification as to "the applicability in wartime of provisions of international law").

<sup>171</sup> William M. Arkin, *The Environmental Threat of Military Operations*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT, *supra* note 22, at 116, 117; Hans-Peter Gasser, *For Better Protection of the Natural Environment in Armed Conflict: A Proposal for Action*, 89 AM. J. INT'L L. 637, 640 (1995); Hans-Peter Gasser, *The Debate to Assess the Need for New International Accords*, in PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICT, *supra* note 22, at 521, 525; Arthur H. Westing, *In Furtherance of Environmental Guidelines for Armed Forces During Peace and War*, in THE ENVIRONMENTAL CONSEQUENCES OF WAR, *supra* note 110, at 179; Stephanie N. Simonds, Note, *Conventional Warfare and Environmental Protection: A Proposal for International Legal Reform*, 29 STAN. J. INT'L L. 165, 211-20 (1992) (rejecting unified treaty approach in favor of minor amendment to article 35(3) and increased enforcement of existing international law).

Enforcement proposals included: the development of a "green cross" organization, the use of U.S. armed forces as "greenkeepers" to deter, prevent or punish wartime environmental damage, and assessment of fines for wartime violators. See Jay Austin & Carl Bruch, *The Greening of Warfare*, 15 ENVTL. FORUM 32, 32, 42 (1998); Michael D. Diederich, Jr., "Law of War" and Ecology — *A Proposal for a Workable Approach to Protecting the Environment Through the Law of War*, 136 MIL. L. REV. 137, 160 (1992) (stating that green cross organization has been founded); Parsons, *supra* note 22, at 493 (discussing use of U.S. armed forces as "greenkeepers").

<sup>172</sup> See Bothe, *supra* note 108, at 58.

deepening international law trades off with the more important priorities of enforcing existing law.

On the other side, some scholars support the further development and codification of law relevant to provide greater protections for the environment during warfare. Within this group, some emphasize the importance of applying peacetime laws to armed conflict — they reject the relevance of the peacetime – wartime divide.<sup>173</sup> Others focus on the laws of war framework,<sup>174</sup> including specific weapons prohibitions.<sup>175</sup> Drawing from the success of the chemical and biological weapons taboos, these scholars helped develop and promote the blinding laser protocol and landmines treaty.<sup>176</sup> Now this group is focusing its attention on DUWs, cluster bombs,<sup>177</sup> and the like. The movement for a treaty to ban DUWs bridges the gap between these two factions by supporting the incorporation of a peacetime environmental principle — the precautionary principle — through a case-by-case application in a laws of war context.

Even if the precautionary principle applies in wartime, uncertainty exists as to the substantive action its application requires.<sup>178</sup> Questions remain, such as whether the precautionary principle requires a particular

<sup>173</sup> The proposal was first suggested in Richard A. Falk, *Environmental Warfare and Ecocide*, 4 BULL. PEACE PROPOSALS 80, 80-86 (1973), and further developed in Falk, *supra* note 110, at 44.

<sup>174</sup> Falk, *supra* note 110, at 42-43; Falk, *The Inadequacy of the Existing Legal Approach to Environmental Protection in Wartime*, in THE ENVIRONMENTAL CONSEQUENCES OF WAR, *supra* note 110, at 137, 150; Plant, *supra* note 109, at 16-17.

<sup>175</sup> Jozef Goldblat, *Legal Protection of the Environment Against the Effects of Military Activities*, 22 BULL. PEACE PROPOSALS 399, 405 (1991); David A. Kaye & Steven A. Solomon, *The Second Review Conference of the 1980 Convention on Certain Conventional Weapons*, 96 AM. J. INT'L L. 922, 936 (2002) (discussing trend in 1990s of "the negotiation of binding legal instruments as the principal answer to ameliorating the hazards of war"); Michael N. Schmitt, *Armed Conflict and Law in This Century*, 30 HUM. RTS. 3, 3 (Winter 2003).

<sup>176</sup> Richard Price, *Reversing the Gun Sights: Transnational Civil Society Targets Land Mines*, 52 INT'L ORG. 613, 629 (1998).

<sup>177</sup> Thomas Michael McDonnell, *Cluster Bombs Over Kosovo: A Violation of International Law?*, 44 ARIZ. L. REV. 31, 129 (2002).

<sup>178</sup> BOUVIER, *supra* note 170, at Part III, ¶ 10, available at <http://www.icrc.org/Web/Eng/siteeng0.nsf/html/5DEESV> ("[The Precautionary Principle] appears mainly in recent treaties and other instruments designed for peacetime. Its possible applicability in armed conflict needs further study even if the precautionary principle is indeed already partially present in international humanitarian law treaties, in particular in Article 36 of Protocol I, which governs the development of new weapons."); McIntyre & Mosedale, *supra* note 161, at 223 ("[D]ue to the fact that it has appeared in a variety of forms, the precise content of the obligation, if indeed such an elusive concept can be subject to substantive definition, remains a matter of uncertainty.").

level of likely harm before it is triggered or what actions must be taken in order to comply with the precautionary principle.<sup>179</sup> Although one can imagine some situations that would clearly call for both the application of the precautionary principle and a particular response, most cases present a more complicated picture. As addressed below, the question of whether the precautionary principle dictates a ban on DUWs depends both on the status of the scientific debate and the strength of the formulation of the principle.

### B. Current Developments

Along with international law restrictions, various states and regional governance institutions have begun to address DUWs. For instance, in 2001, the European Parliament adopted a resolution on DUWs use in response to concerns that European peacekeeping forces were suffering from DU-induced cancer.<sup>180</sup> The resolution acknowledged that "there is as yet no clearly established medical or statistical proof of a link between [DUWs] and the occurrence of leukemia and other forms of cancer, as well as other diseases . . . ."<sup>181</sup> The resolution also called upon NATO member states to undertake a moratorium on DUWs "in accordance with the precautionary principle . . . ."<sup>182</sup> In 2003, the European Parliament reaffirmed this call for a moratorium and asked the European Commission to monitor DU's effects in relation to "possible serious, widespread contamination of the environment, as well as any acute or appreciable long-term hazard to human health."<sup>183</sup> Among those European states that possess DUWs, the United Kingdom may be phasing out its DUWs use,<sup>184</sup> and Greece has removed DUWs from its

<sup>179</sup> TROUWBORST, *supra* note 13, at 286.

<sup>180</sup> Resolution on the Consequences of Using Depleted Uranium Munitions, 2001 O.J. (C 262) 167 [hereinafter DU Resolution]. In addition, a special rapporteur on DU was appointed during the 2001 session of the U.N. Subcommission on the Prevention of Discrimination Against Minorities. Stephanie Hiller, *Karen Parker: Fighting to Stop the Use of Illegal Weapons* (Feb. 4, 2004), [http://www.awakenedwoman.com/karen\\_parker.htm](http://www.awakenedwoman.com/karen_parker.htm).

<sup>181</sup> DU Resolution, *supra* note 180, at B.

<sup>182</sup> *Id.* at I.6 (referring back to resolution on precautionary principle, but stating that resolution does not define precautionary principle either); Resolution on the Commission Communication on the Precautionary Principle, 2000 O.J. (C 232) 345, available at [http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/c\\_232/c\\_23220010817en03450350.pdf](http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/c_232/c_23220010817en03450350.pdf).

<sup>183</sup> Resolution on the Harmful Effects of Unexploded Ordinance (Landmines and Cluster Submunitions) and Depleted Uranium Ammunition, 2004 O.J. (C 43) 361.

<sup>184</sup> Britain is using DU in Iraq, but is phasing DUWs out of its tanks and ships. See Sean Rayment, *Army's New Tank Gun Will End Use of Controversial Uranium-Tipped Shells France*,

arsenal.<sup>185</sup> In light of these current developments, relations with many European countries may suffer if the United States continues to use DUWs.<sup>186</sup>

In contrast with these European nations, the United States currently allows combat use of DUWs and DU-coated tanks. Army Training Manuals require respiratory and skin protection for any personnel in close proximity of contaminated equipment.<sup>187</sup> The military recommends counseling for exposed personnel and their family members.<sup>188</sup> Yet no regulations require the notification of civilian populations about possible contamination. The United States infrequently discloses where it has used DU after conflicts, but it is not internally bound to do so.<sup>189</sup> The United States has conducted few tests of soldiers exposed to DU in the Gulf War,<sup>190</sup> and the DOD has ignored regulations about medical testing for servicepersons with possible DU exposure.<sup>191</sup> In 2003, Senators Hillary Clinton and Chuck Schumer introduced a bill to study the possible health effects of DUWs, to require remediation of domestic DU production sites, and to encourage remediation of foreign sites.<sup>192</sup>

Meanwhile, the International Coalition to Ban Uranium Weapons recently drafted a convention to ban the development, production, stockpiling, transfer, and use of DUWs.<sup>193</sup> The convention also obligates

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*Spain and Italy All Claim that Soldiers in Bosnia and Kosovo Have Contracted Cancer*, SUNDAY TELEGRAPH (London), Sept. 21, 2003, at 7 (documenting that Royal Ordnance ceased production); Kim Sengupta, *NATO Faces Inquiry into Uranium 'War Crimes'*, INDEP. (London), Jan. 15, 2001, at 2 (discussing Britain's proposed phase out of DUWs on ships).

<sup>185</sup> Myers, *supra* note 22.

<sup>186</sup> Spencer & Scardaville, *supra* note 30 (stating, "The controversy that erupted after the soldiers were found to have leukemia is threatening to undermine the alliance structure in Europe."); Tomas Valasek, *How Depleted Uranium Eroded U.S.-European Defense Cooperation*, WEEKLY DEF. MONITOR, Jan. 11, 2001, available at <http://webnetarts.com/socialjustice/du.html>.

<sup>187</sup> Sara Flounders, *Another War Crime? Iraqi Cities "Hot" with Depleted Uranium* (Aug. 18, 2003), <http://www.iacenter.org/depleted/du-warcrime.htm>.

<sup>188</sup> U.S. ARMY CTR. FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE & THE U.S. ARMY HEAVY METALS OFFICE, *supra* note 70, at 6.3.

<sup>189</sup> Dan Fahey, *Depleted Uranium: America's Military "Gift" That Keeps on Giving*, L.A. TIMES, Feb. 18, 2001, at A2.

<sup>190</sup> Fahey, *supra* note 27, at 30-31.

<sup>191</sup> U.S. ARMY CTR. FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE & THE U.S. ARMY HEAVY METALS OFFICE, *supra* note 70, at 6.3.

<sup>192</sup> H.R. 1483, 108th Cong. (2003). The bill is still languishing in a House subcommittee.

<sup>193</sup> Manfred Mohr & A. Samsel, *Ban Uranium Weapons: Executive Summary* (Oct. 31, 2004), <http://www.bandepleteduranium.org/modules.php?name=News&file=article=160>.

state parties to remediate contaminated areas.<sup>194</sup> No states have joined the treaty, as it has not been opened for signature, but the draft treaty requires a mere twenty ratifications to enter into force. The drafters view the treaty ban as the legal solution to the problem posed by DUWs under the precautionary principle.<sup>195</sup>

### III. CRITICISMS OF THE ENVIRONMENTAL ARGUMENT FOR BANNING DUWs

DUWs provide a useful case study demonstrating the inherent limitations of a military precautionary principle. One criticism focuses on the possible misapplication of the precautionary principle — DUWs do not obviously satisfy either the intermediate or the strong version of the precautionary principle. A second criticism suggests that even if the requirements of the precautionary principle are met, its application ignores similar risks raised by alternative weapons and from cleaning DU contaminated sites. Finally, a brief glance at the military and financial costs of banning DUWs suggests that doing so would likely fail any cost-sensitive version of the precautionary principle.

#### A. *Is the Precautionary Principle Satisfied?*

The synthesized version of the precautionary principle suggests that in the presence of a threat of (non-negligible) environmental harm accompanied by scientific uncertainty, regulatory action should nevertheless be taken to prevent or remedy the hazard concerned.<sup>196</sup> Two possible tests exist for determining whether a threat of a harm exists: (1) reasonable scientific possibility and (2) reasonable scientific probability.<sup>197</sup> Reasonable scientific possibility exists “whenever empirical scientific data provide a rational basis that warrants drawing the conclusions from the data, even though reasonable scientific experts might disagree on whether that conclusion is the only valid inference

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<sup>194</sup> *Id.*

<sup>195</sup> ICBUW NETHERLANDS, BAN URANIUM WEAPONS: ON THE PRECAUTIONARY PRINCIPLE, THE DU DRAFT CONVENTION, THE BURDEN OF PROOF, AND THE ICRP 14, 23 (Karel Koster & Carolyn d’Hesse Rogers eds., 2004), available at <http://www.bandepleteduranium.org/modules.php?mop=modload&name=Upload&file=index&op=getit&fid=16> (providing “Verbatim Account” of presentation by Manfred Mohr and panel’s conclusions).

<sup>196</sup> See *supra* note 12.

<sup>197</sup> James E. Hickey, Jr. & Vern R. Walker, *Refining the Precautionary Principle in International Environmental Law*, 14 VA. ENVTL. L.J. 423, 449 (1995).

from the data.”<sup>198</sup> Reasonable scientific probability exists “whenever scientific experts generally agree that the available data are valid and reliable, and when there is also general acceptance by the relevant scientific community of the specific conclusions drawn from the data.”<sup>199</sup>

Several studies suggest that the harm presented by DUWs is negligible or nonexistent.<sup>200</sup> No empirical evidence about the long-term effects of DUWs is yet available. Thus, one could fairly conclude that neither test is satisfied. The precautionary principle does not indicate which studies to prefer or what models to base our scientific presumptions upon. This is a situation where one can identify possible risks, but there is no agreement as to the probability of those risks being actualized.

Ultimately, the precautionary principle is often indeterminate in practice. Although all rules and principles contain some degree of flexibility, the precautionary principle as applied in the military context is at the far end of the spectrum of indeterminacy. In domestic law, implementation of the precautionary principle is generally accompanied by specific textual constraints. Then the ensuing case law interpreting the various components helps make the principle’s terms more determinate over time. When advocates say the precautionary principle is part of customary international law or part of article 36 of Protocol I, however, little exists beyond those laws to guide the determination of what level of scientific uncertainty satisfies the principle.

*B. Does the Precautionary Principle Adequately Address the Harms?*

This section contends that the precautionary principle, as defended in the legal scholarship and particularly in the DUWs context, ignores risks posed by alternative weapon systems.<sup>201</sup> While scientific uncertainty need not prevent regulation, a single-minded focus on uncertainty ignores the reality that regulation always occurs in a world of substitutes that also need assessment.<sup>202</sup> Similarly, the demand for total remediation

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<sup>198</sup> *Id.*

<sup>199</sup> *Id.*

<sup>200</sup> See *supra* Part I.B.

<sup>201</sup> The precautionary principle need not be blind to risk-risk balancing. Andre Nollkaemper, “What You Risk Reveals What You Value”, and Other Dilemmas Encountered in Legal Assaults on Risk, in *THE PRECAUTIONARY PRINCIPLE AND INTERNATIONAL LAW*, *supra* note 161, at 73, 91; TICKNER ET AL., *supra* note 85, 9-10 (suggesting that evaluation of alternatives is part of precautionary principle). Yet, none of the current formulations alluded to in the DU literature reflect a willingness to attend to risks across weapons.

<sup>202</sup> Huber, *supra* note 65, at 1085.

ignores the likely resulting risk-risk tradeoffs and financial costs.

Before the U.S. government or international community further regulates DUWs and DU armor, they should assess the health and environmental impact of the alternatives to such weapons. This assessment mirrors comparative risk regulation in the domestic arena, which defines risk markets by identifying functional substitutes and then comparing the risks of the new good to those already accepted in the market.<sup>203</sup> This section presents the three most likely alternatives to DUWs: tungsten tank ammunition, seek-and-destroy munitions, and aerially delivered cluster bombs.<sup>204</sup> This discussion is not an exhaustive list of alternatives nor of the relevant comparisons, but it provides a starting point of the relevant considerations.

Neither side of the DU debate seems to fully discuss all of the relevant harms and costs of regulating DUWs and DU armor. Rather, the environmental advocates focus on the environmental and health harms to civilians. Similarly, the military emphasizes the military and financial costs. To help visualize the different costs that should be assessed, a brief graph is provided below.

Weapons	Environ-	Health	Health	Financial	Military
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<sup>203</sup> *Id.* at 1075-76.

<sup>204</sup> Widescreen regulation does pose its own risks. Accounting for the risks of alternatives and indirect risks of regulations can decrease the overall quality of decision making. Dana, *supra* note 20, at 1337. The research into alternatives and into the harms from regulations might be used to postpone regulation indefinitely. *Id.*



	<b>mental Harms</b>	<b>Harms to Civilians</b>	<b>Harms to Military Personnel</b>	<b>Costs</b>	<b>Costs</b>
Depleted Uranium Weapons	1. Radiation 2. Chemical toxicity	1. Radiation 2. Genotoxicity 3. Chemical toxicity	1. Radiation 2. Genotoxicity 3. Chemical toxicity	Cheap compared to other weapons, as DU is a waste product	Better than tungsten, but often misses its target
Tungsten	1. Chemical toxicity	1. Genotoxicity 2. Chemical toxicity	Unknown, but probably low	Expensive compared to other weapons — must be imported	Effective against older tanks
Seek-and-Destroy Munitions	Unknown	1. Chemical toxicity (very few studies in this area)	Unknown, but probably low (no studies in this area)	Very expensive compared to other weapons	Unknown
Cluster Bombs	Leaches into the soil over time no scientific consensus about seriousness of risk	Similar to landmines — death and amputations; certainty about risk and likely affected populations	Similar to landmines — death and amputations; certainty about risk and likely affected populations	Cheap compared to other weapons	Effective, but requires change in military strategy

### 1. Health Risks from Alternatives

Tungsten tank ammunition, a nonradioactive heavy metal product, presents the most likely alternative to DUWs.<sup>205</sup> DUW opponents claim that tungsten poses no health risks.<sup>206</sup> While tungsten certainly creates no radiation-related risks,<sup>207</sup> current studies suggest that tungsten presents a nontrivial cancer risk.<sup>208</sup> Tungsten's possible reproductive and developmental effects have not been studied,<sup>209</sup> but it may be genotoxic.<sup>210</sup> This means that over the long-term, tungsten may present the same risk as DUWs to the water and food supply, based on its heavy metal content.<sup>211</sup>

Seek-and-destroy munitions ("SADARMS") present another possible alternative to DU munitions.<sup>212</sup> SADARMS are precision-guided artillery shells.<sup>213</sup> Using current research, it is difficult to guess whether SADARMS outperform DUWs on the health and environmental axis. SADARMS contain significant amounts of tantalum<sup>214</sup> which, like uranium, is a toxic heavy metal.<sup>215</sup> Reports suggest that tantalum may be highly toxic when it vaporizes,<sup>216</sup> perhaps presenting a greater short-term danger than uranium. Preliminary studies comparing the relative carcinogenic effects of DU to tantalum are underway, but no results have

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<sup>205</sup> Spencer & Scardaville, *supra* note 30.

<sup>206</sup> Physicians for Social Responsibility, *supra* note 32 ("Tungsten, for example, has the same density as DU, but it has not been known to have negative consequences on human and environmental health.").

<sup>207</sup> HULME, *supra* note 49, at 247.

<sup>208</sup> A.C. Miller et al., *Potential Late Health Effects of Depleted Uranium and Tungsten Used in Armor Piercing Munitions: Comparison of Neoplastic Transformation and Genotoxicity with the Known Carcinogenic Nickel*, 167 MIL. MED. 120, 120 (2002).

<sup>209</sup> CTR. FOR DISEASE CONTROL, CHURCHILL COUNTY (FALLON), NEVADA EXPOSURE ASSESSMENT (June 11, 2003), available at <http://www.cdc.gov/nceh/clusters/Fallon/faq-tungsten.htm>.

<sup>210</sup> Graham-Rowe, *supra* note 66.

<sup>211</sup> HULME, *supra* note 49, at 247 (suggesting that tungsten presents "similar toxicological risks to DU").

<sup>212</sup> Spencer & Scardaville, *supra* note 30; see also David Hambling, *Why Deadly Depleted Uranium Is the Weapon of Choice*, GUARDIAN UNLIMITED, May 18, 2000, available at <http://education.guardian.co.uk/tefl/lesson/article/0,222282,00.html>.

<sup>213</sup> Spencer & Scardaville, *supra* note 30.

<sup>214</sup> Hambling, *supra* note 212.

<sup>215</sup> Spencer & Scardaville, *supra* note 30. Tantalum is widely used in domestic products and no restrictions on tantalum's military applications currently exist. See Neil Baumgardner, *Army Positions SADARM Rounds in Kuwait*, DEF. DAILY, Mar. 10, 2003.

<sup>216</sup> Hambling, *supra* note 212.

been reported.<sup>217</sup>

The United States could also shift its military strategies away from tank busters in favor of heavier air campaigns. Such campaigns often rely on the heavy use of cluster bombs. Pilots carrying these bombs face difficulties both in correctly identifying military targets and in hitting the intended targets,<sup>218</sup> which means that cluster bombs often cause significant injuries to civilians and civilian infrastructure. In addition, cluster bombs often fail to explode<sup>219</sup> — the average dud rate is somewhere between 5 and 15%.<sup>220</sup> After the conflict, unexploded cluster bombs<sup>221</sup> remain in the environment until they are accidentally detonated by civilians or cleared by debombers.<sup>222</sup> The resulting cluster bomb injuries often require multiple surgeries and amputations.<sup>223</sup> Children face the greatest risk from cluster bombs — their natural inquisitiveness and playfulness render them vulnerable to unexploded ordnance. Moreover, cluster bombs impede access to vital resources, like arable land and water supplies.<sup>224</sup> Thus, even limited use of cluster bombs generates substantial health and environmental harms.<sup>225</sup>

<sup>217</sup> Fletcher Hahn, *Carcinogenicity of Depleted Uranium Fragments*, <http://www.gulflink.osd.mil/medsearch/Cancer/DOD7B.shtml> (last visited Dec. 10, 2005).

<sup>218</sup> Virgil Wiebe, *Footprints of Death: Cluster Bombs as Indiscriminate Weapons Under International Humanitarian Law*, 22 MICH. J. INT'L L. 85, 105-10 (2000).

<sup>219</sup> In fairness, the United States could focus on reducing the dud problem. See Deb Riechmann, *War Leaves Unexploded Bombs in Afghanistan*, CHARLESTON GAZETTE (W. Va.), Dec. 26, 2001, at 5C (stating that Senator Patrick Leahy maintains that "[t]he Army has developed a reliable self destruct fuse [for cluster bombs] that would have reduced that number of duds [14,000] to under 500").

<sup>220</sup> For various estimates, see Rachel Stohl, *Cluster Bombs Leave Lasting Legacy*, WEEKLY DEF. MONITOR, Aug. 5, 1999, available at <http://www.cdi.org> (reporting DOD's claim that dud rate in Kosovo was 5%); Mennonite Central Committee on Cluster Bomb Use, *Production and Transfer, Call for a Moratorium on Cluster Bomb Use, Production and Transfer* (Apr. 23, 2003), <http://www.mcc.org/clusterbomb/moratorium/index.html> (claiming that average dud rate is 10-15%, but can range as high as 30%).

<sup>221</sup> The United States military systematically underestimates the dud problem. RAE MCGRATH, CLUSTER BOMBS: THE MILITARY EFFECTIVENESS AND IMPACT ON CIVILIANS OF CLUSTER MUNITIONS 7 (2001), available at [http://www.landmineaction.org/resources/Cluster\\_Bombs.pdf](http://www.landmineaction.org/resources/Cluster_Bombs.pdf).

<sup>222</sup> See *id.* at 30-31.

<sup>223</sup> Carmel Capati, Note, *The Tragedy of Cluster Bombs*, 16 WIS. INT'L L.J. 227, 232 (1997).

<sup>224</sup> SHAWN ROBERTS & JODY WILLIAMS, *AFTER THE GUNS FALL SILENT: THE ENDURING LEGACY OF LANDMINES* 6 (1995).

<sup>225</sup> For instance, the cluster bomb attacks in Kosovo were responsible for "18 to 30 percent of all civilian deaths" during the conflict. Human Rights Watch, *Backgrounder: Cluster Bombs in Afghanistan* (Oct. 2001), <http://www.hrw.org/backgrounder/arms/cluster-bck1031.htm>.

## 2. Health Risks from Remediation

In the status quo, the United States has no DU cleanup plans for Iraq or other contaminated countries. Without remediation, some fear that discarded DUWs pose a long-term threat to both the environment and civilian populations. Long-term exposure risks include DU leaching into groundwater and soil, civilians using radioactive and toxic materials in their homes and businesses, and children ingesting irradiated and toxic soil in contaminated play sites. Scientific uncertainty confounds the quantification of the long-term risks of DU, although, as described previously, the growing trend of evidence suggests that heavy metal toxicity, rather than radiation, poses the greater problem.

Many versions of the precautionary principle demand full-scale remediation in such a situation. Remediation has significant benefits. A thorough cleanup eliminates the vast majority of risk to civilians who did not suffer from high initial exposures.<sup>226</sup> It also alleviates the fear of radiation and its resultant illnesses and costs.<sup>227</sup> Remediation addresses concerns about the possible intergenerational effects of DUWs and massively reduces the ingestion risk to children.

Yet many versions of the precautionary principle also display blindness to the health and environmental risks of remediation. Remediation creates substantially increased exposure for cleanup workers, often well beyond what the average individual would face in a world without remediation.<sup>228</sup> In addition to the radiation and toxicological risks, DU removal workers must often contend with the hazard of unexploded ordnance.<sup>229</sup>

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<sup>226</sup> It is worth noting, however, that it is unclear how much benefit is attained by trying to return to background levels of radiation. For instance, biodiversity has flourished in the evacuation zone around Chernobyl, suggesting that over the long-term, the previous strain of human activities were worse for that particular area than was the radioactive waste. Letter to the Editor, *The Chernobyl Disaster and Subsequent Creation of a Wildlife Preserve*, 19 ENVTL. TOXICOLOGY & CHEMISTRY 1231, 1231-32 (2000).

<sup>227</sup> Dan Fahey, *Report on the International Conference on Low-Level Radiation Injury and Medical Countermeasures, Military Toxics Project 4* (Nov. 10, 1999), [http://www.ngwrc.org/files/NGWRC/documents/documents/Archives/Misc/report\\_international\\_conference.doc](http://www.ngwrc.org/files/NGWRC/documents/documents/Archives/Misc/report_international_conference.doc). For instance, if people refuse to use DU-contaminated land or water, this may strain other resources.

<sup>228</sup> John S. Applegate & Steven M. Wesloh, *Short Changing Short-Term Risk: A Study of Superfund Remedy Selection*, 15 YALE J. REG. 269, 277-96 (1998).

<sup>229</sup> SUSAN D. LANIER-GRAHAM, *THE ECOLOGY OF WAR* 63-65 (1993); ARMY ENVTL. POLICY INST., *HEALTH AND ENVIRONMENTAL CONSEQUENCES OF DEPLETED URANIUM USE BY THE U.S. ARMY*, EXECUTIVE SUMMARY ch. 7 (June 1994), available at <http://www.fas.org/man/dod-101/sys/land/du.htm> [hereinafter ARMY ENVTL. POLICY

Current cleanup methods raise another issue. Because soil remediation often causes soil erosion, it increases the risk of DU exposed soil migrating to previously uncontaminated areas<sup>230</sup> and exposing entirely new populations. Further, current cleanup methods dictate removing the “top level of soil,” which threatens the productivity and sustainability of arable land or wetlands.<sup>231</sup> As a result, cleanups, on balance, can kill more than they save through the combination of increased prolonged exposure, unsettling hazardous particles, exposure to other hazards like landmines and cluster bombs, and the creation of new environmental dangers.<sup>232</sup>

Furthermore, the costs of full remediation far exceed reasonable estimates of benefits to civilian populations. The estimated cost to fully remediate 152,000 pounds of DU, the amount used in Jefferson Proving Grounds, a military testing site, is in the billions of dollars.<sup>233</sup> Removal is also extremely time consuming — even under optimal conditions it takes up to over an hour to remove one DU projectile from a battle zone.<sup>234</sup> Compared to total remediation, a combination of educational campaigns, cordoning off the least utilized areas, and minimal remediation provide a more sustainable strategy. Effective information dissemination may help both reduce exposure and allay fears about the risks of DU. Education campaigns and cordoning off the most contaminated sites substantially reduces external and ingestion exposure, but has limited effect on inhalation exposure and long-term ingestion through agriculture and water. The solution is minimal remediation, which removes the visible reminders of DU’s presence and thus helps put people at ease.<sup>235</sup> This combination is more expensive than the no-action strategy but substantially cheaper than the full cleanup strategy.<sup>236</sup>

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<sup>230</sup> ARMY ENVTL. POLICY INST., *supra* note 229, ch. 3. For instance, regulations demanding complete removal of asbestos in schools actually increased exposure by exposing previously contained fibers to accessible areas of schools. Cross, *supra* note 61, at 899.

<sup>231</sup> ARMY ENVTL. POLICY INST., *supra* note 229, ch. 3.

<sup>232</sup> Cross, *supra* note 61, at 900.

<sup>233</sup> Scott Peterson, *Pentagon Stance on DU a Moving Target*, CHRISTIAN SCI. MONITOR, Apr. 30, 1999, at 2.

<sup>234</sup> LANIER-GRAHAM, *supra* note 229, at 65.

<sup>235</sup> See Mark Miller et al., *An Alternative for Cost-Effective Remediation of Depleted Uranium (DU) at Certain Environmental Restoration Sites*, 78 HEALTH PHYSICS S9, S12 (2000).

<sup>236</sup> For instance, the lowest cost remediation strategy for Jefferson Proving Ground is estimated at less than 10 million, which is several magnitudes of cost lower than the price-tag for complete remediation. ARMY ENVTL. POLICY INST., *supra* note 229, ch. 1.

### 3. Military and Economic Costs

Most formulations of the precautionary principle deliberately ignore the military and economic costs of the proposed regulation. In a world where only those policies that cause “serious or irreversible damage” trigger the precautionary principle, perhaps this is a defensible precommitment strategy. On the other hand, without adequate policing of what triggers the precautionary principle, application of the precautionary principle accrues substantial military and economic costs.

For example, the precautionary principle ignores the very real military and financial burdens of shifting away from the use of DUWs. As tungsten lacks DU’s pyrophoric effect, it is militarily inferior to DUWs.<sup>237</sup> As discussed above, less effective ammunition protracts combat and risks increased casualties.<sup>238</sup> Given the condition of our likely enemies’ tanks, however, tungsten may provide sufficient firepower to quickly end battles.<sup>239</sup> Thus, tungsten may adequately serve our existing needs, but DUWs allow greater flexibility for unanticipated and more sophisticated threats. Tungsten ammunition also poses a greater fiscal burden than DUWs — the United States imports tungsten from China and Russia at a high cost.<sup>240</sup>

SADARMS pose their own set of military and financial costs. Not only have they not been put into widespread production,<sup>241</sup> but SADARMS have also been neither combat-tested nor extensively field tested,<sup>242</sup> so their military efficaciousness is relatively unknown. The success rate of other precision-guided military technology might provide a useful first-cut comparison.<sup>243</sup> This precision-guiding technology is quite costly,

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<sup>237</sup> Spencer & Scardaville, *supra* note 30.

<sup>238</sup> See *supra* Part I.B.

<sup>239</sup> Fahey, *supra* note 38, at 8 (“It is unclear whether DU rounds are really a military necessity or whether 120 mm tungsten alloy rounds could as efficiently destroy the antiquated tanks in the arsenals of Iraq, Iran, Syria, North Korea and other potential adversaries.”).

<sup>240</sup> Spencer & Scardaville, *supra* note 30. The need to import tungsten also raises a separate concern — the importation reduces our country’s independence in weapons production. On the other hand, as the United States has already committed to importing tungsten for rifle bullets, it seems that this concern is not highly valued and is nonunique.

<sup>241</sup> A few hundred rounds have been positioned in Kuwait. Baumgardner, *supra* note 215.

<sup>242</sup> *Id.*

<sup>243</sup> For instance, laser-guided bombs were extremely effective in the first Gulf War. RICHARD P. HALLION, PRECISION GUIDED MUNITIONS AND THE NEW ERA OF WARFARE, AIR POWER STUDY CENTRE PAPER 53 (1995), available at <http://www.fas.org/man/dod-101/sys/smart/docs/paper53.htm>.

however, making SADARMS significantly more expensive than DUWs, though an exact financial comparison is impossible at this stage.<sup>244</sup>

As for cluster bombs, the United States currently deploys them, so increasing the number in the arsenal is unlikely to present a significant cost burden, although it may be more expensive to use planes and cluster bombs rather than tanks and DUWs. When they make contact,<sup>245</sup> cluster bombs are effective against military objectives and are particularly effective as antitank devices.<sup>246</sup> Yet, because of their high miss rate and dud potential (failure to explode on contact), pilots are often forced to deliver additional runs which expose them to further risks.<sup>247</sup>

These brief comparisons demonstrate one paradox of the precautionary principle. Advocates urge the abandonment of a newly developed weapon because of its uncertain health and environmental consequences, but no mechanism is in place to account for the health and environmental consequences of the weapon's alternative systems. Assuming the question of whether to use DUWs is a regulatory one, the costs and benefits of the likely alternatives must be further developed before the question can be answered.

#### IV. COGNITIVE INSIGHTS

Cognitive bias literature helps explain how people make decisions under conditions of uncertainty.<sup>248</sup> Behavioral law and economics uses insights from the cognitive bias literature to account for limitations on the rationality of actual people. Behavioral law and economics presumes that people are subject to bounded rationality; in other words, they possess finite cognitive abilities.<sup>249</sup> While many instances of bounded rationality exist, this Article focuses on the deployment of heuristics to

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<sup>244</sup> Sandra I. Erwin, *Army Initiates Study to Measure Value of Precision-Guided Weapons*, NAT'L DEF., Nov. 2004, available at <http://www.nationaldefensemagazine.org/issues/2004/Nov/Precision-GuidedWeapons.htm>.

<sup>245</sup> MCGRATH, *supra* note 221, at 48.

<sup>246</sup> *Id.* at 52.

<sup>247</sup> Michael J. Matheson, *Filling the Gaps in the Convention Weapons Convention*, ARMS CONTROL TODAY, Nov. 2001, available at [http://www.armscontrol.org/act/2001\\_11](http://www.armscontrol.org/act/2001_11).

<sup>248</sup> Thomas Gilovich et al., *Preface* to HEURISTICS AND BIASES: THE PSYCHOLOGY OF INTUITIVE JUDGMENT, at xv (Thomas Gilovich et al. eds., 2002) [hereinafter HEURISTICS AND BIASES].

<sup>249</sup> Christine Jolls et al., *A Behavioral Approach to Law and Economics*, in BEHAVIORAL LAW AND ECONOMICS 13, 14 (Cass R. Sunstein ed., 2000).

help cope with uncertainty. Heuristic devices, or rules of thumb, are often used as shortcuts for decision-making.<sup>250</sup> Employing these shortcuts in times of uncertainty is frequently rational. Research suggests, however, that in certain situations, heuristics can lead to systematic errors.<sup>251</sup>

Domestic legal scholarship, most notably behavioral law and economics, has incorporated the cognitive bias literature,<sup>252</sup> but international law scholars have been slow to warm to its insights.<sup>253</sup> Yet with the increasing role of civil society in shaping the international law agenda, the question of how the public approaches uncertainty is just as relevant in international law as it is in domestic law. This section grapples with the question of how the public responds to particular instances of uncertainty in order to generate predictions about future regulatory trends. While the precautionary principle provides a framework to deal with uncertainty, it does not predict when the public will ask for its application. Thus, this section uses cognitive biases to help explain why civil society has chosen to focus on DUWs<sup>254</sup> and more generally, how a military precautionary principle will be deployed.

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<sup>250</sup> See Cass R. Sunstein, *Introduction* to BEHAVIORAL LAW AND ECONOMICS, *supra* note 249, at 1, 3.

<sup>251</sup> See generally HEURISTICS AND BIASES, *supra* note 248 (discussing variety of different systematic errors triggered by heuristics).

<sup>252</sup> See Robert A. Prentice, *Chicago Man, K-T Man, and the Future of Behavioral Law and Economics*, 56 VAND. L. REV. 1663, 1664 n.10 (2003) (providing brief bibliography of domestic law articles incorporating behavioral law and economics concepts).

<sup>253</sup> A few pieces discuss cognitive biases in the public international law literature. See, e.g., Oren Gross, *Chaos and Rules: Should Responses to Violent Crises Always Be Constitutional?*, 112 YALE L.J. 1011 (2003); John Norton Moore, *Beyond the Democratic Peace: Solving the War Puzzle*, 44 VA. J. INT'L L. 341, 376 (2004); Jeffrey J. Rachlinski, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299; Arie Reich, *The WTO as a Law-Harmonizing Institution*, 25 U. PENN. J. INT'L ECON. L. 321, 376 (2004); Note, *Responding to Terrorism: Crime, Punishment, and War*, 115 HARV. L. REV. 1217 (2002).

<sup>254</sup> This issue is beginning to break through domestic public consciousness. For instance, presidential contender Dennis Kucinich included banning DU and promoting remediation as part of his platform. Dennis Kucinich, *Depleted Uranium*, [http://www.kucinich.us/issues/depleted\\_uranium.php](http://www.kucinich.us/issues/depleted_uranium.php) (last visited Nov. 10, 2005); see also Ann Goodgion et al., *The Real Enemy: Depleted Uranium*, POST-STANDARD/HERALD-J (N.Y.), Nov. 14, 2004, available at 2004 WL 58039172; Paul Martin & Maria Cedrell, *Arafat Says Bullets Raising Cancer Rates: Depleted Uranium Claim Disputed*, WASH. TIMES, July 21, 2004, available at 2004 WL 64161229; Katherine Vander Horck, *U.S. Use of Depleted Uranium Is Inexcusable*, DULUTH NEWS TRIB. (Minn.), Feb. 12, 2005, available at 2005 WL 1990730; *Depleted Uranium*, BANGOR DAILY NEWS (Me.), Nov. 24, 2004, available at 2004 WL 83767853.



*A. Availability*

One way to raise public concern about a particular risk is through the use of the availability heuristic. The availability heuristic dictates that “[p]eople tend to think that risks are more serious when an [incident] is readily called to mind or ‘available.’”<sup>255</sup> In general, two factors determine the availability of environmental hazards: observed frequency and salience.<sup>256</sup> Interested parties and the media help influence the salience of a particular risk by framing the risk for public consumption.<sup>257</sup> In turn, as more people begin to draw on the same frames or images, the heuristic can become so magnified that it eventually turns into an availability cascade triggering exponentially increased support for the issue.<sup>258</sup>

In an effort to activate the availability heuristic, interest groups opposed to DUWs, such as NGOs, connect the harms of DUWs to Chernobyl,<sup>259</sup> Agent Orange,<sup>260</sup> and the Gulf War Syndrome.<sup>261</sup> In so doing, they encourage the public to easily imagine the harms of DUWs by linking them to other perceived high-risk situations. For instance, one effort to generate the availability heuristic emphasizes the similarity between the possibility of nuclear power reactor accidents with DUWs, in terms of the harms of radiation exposure.<sup>262</sup> The American public strongly fears nuclear power and perceives its risks as dreaded, uncontrollable, inequitable, catastrophic, and likely to affect future generations.<sup>263</sup> Fear of nuclear power and nuclear weapons also stems from a fear of technology. For example, while humans constantly experience natural low-level radiation, there is special concern for man-made radiation.<sup>264</sup> Nuclear fear is deeply embedded in the American

<sup>255</sup> Sunstein, *supra* note 250, at 5.

<sup>256</sup> See Jolls, *supra* note 249, at 37.

<sup>257</sup> *Id.*

<sup>258</sup> See Timur Kuran & Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683, 685 (1999). Availability entrepreneurs may exacerbate flaws in the public’s decisions by “advocating anecdote driven policy” to legislators. See Jolls, *supra* note 249, at 38-39.

<sup>259</sup> Letter from Leuren Moret, President, Scientists for Indigenous People, to the Honorable Jim McDermott (Feb. 21, 2003), <http://traprockpeace.org/LettertoMcDermott.pdf>.

<sup>260</sup> See, e.g., Clark, *supra* note 54, at 15.

<sup>261</sup> See *supra* note 75.

<sup>262</sup> See *supra* note 260.

<sup>263</sup> Slovic et al., *supra* note 86, at 31.

<sup>264</sup> See Ralph E. Lapp, *The Fallout Controversy*, in PHANTOM RISK, *supra* note 60, at 299,

consciousness<sup>265</sup> — the public connects it to the secret development of nuclear weapons and their fear of catastrophic nuclear warfare and nuclear accidents.<sup>266</sup> For many, the accident at Chernobyl is the most salient and vivid embodiment of this nuclear fear. Encouraging the public to equate DUWs with Chernobyl could stimulate a public outcry for regulation of DUWs.<sup>267</sup>

A careful examination of Chernobyl, however, lends little support for a DUWs ban. The reactor meltdown at Chernobyl was an isolated incident that caused the greatest single accidental radioactive release in world history.<sup>268</sup> Such a large release in this small area created a radioactive hot spot.<sup>269</sup> Yet, the use of DUWs would have to be several magnitudes beyond contemplated use in order to replicate this result. Due to their inherent design, DUWs and DU armor release substantially fewer radioactive particles than does a leaking nuclear reactor. This distinction matters — as the difference in exposure level changes the amount of risk posed. Scientific consensus agrees that prolonged exposure to high-level radiation poses clear danger, but no such consensus exists for low-level radiation.

NGOs and other DUWs opponents also encourage the public to compare DUWs to Agent Orange.<sup>270</sup> The domestic public believes Agent Orange caused many Vietnam era illnesses and thinks of it as a metaphor for the harms of the United States's intervention.<sup>271</sup> The

301-05; W. Kip Viscusi, *Carcinogen Regulation: Risk Characteristics and the Synthetic Risk Bias*, 85 AM. ECON. REV. 50, 51 (1995).

<sup>265</sup> Such negative association with radiation is not inevitable — counter-frames are possible. Near universal acceptance of x-ray technology demonstrates that the public can approve of radiation in particular instances. Slovic et al., *supra* note 86, at 33. X-rays are seen differently than is nuclear power because the use of X-rays has become part of the background status quo, its benefits are well understood, and its administrators are trusted. *Id.*

<sup>266</sup> Paul Slovic et al., *Perceived Risk, Trust, and the Politics of Nuclear Waste*, 254 SCI. 1603, 1606 (1991).

<sup>267</sup> See MURRAY FESCHBACH & ARTHUR FRIENDLY, JR., *ECOCIDE IN THE USSR: HEALTH AND NATURE UNDER SIEGE* 248 (1992); CHRIS C. PARK, *CHERNOBYL: THE LONG SHADOW* 179-80 (1989) (contending that Chernobyl awoke antinuclear feeling, resulting in opposition to future and existing nuclear power plants).

<sup>268</sup> Lynn R. Anspaugh et al., *The Global Impact of the Chernobyl Reactor Accident*, 242 SCI. 1513, 1513 (1988).

<sup>269</sup> Nigel Williams, *Chernobyl: Life Abounds Without People*, 269 SCI. 304, 304 (1995).

<sup>270</sup> See John Catalinotto, *A Tale of Two Syndromes: Vietnam and the Gulf War*, in *METAL OF DISHONOR*, *supra* note 27, at 55, 58; Michelle Mairesse, *The Depleted Uranium Cover-Up*, <http://www.trytolive.com/c0339.htm> (last visited Dec. 10, 2005).

<sup>271</sup> Michael Gough, *Dioxin: Perceptions, Estimates, and Measures*, in *PHANTOM RISK*, *supra*

concern for the victims of Agent Orange also embodies the guilt that the public feels for the harm Americans imposed on Vietnamese civilians.<sup>272</sup> The shame Americans feel about the treatment of Vietnam veterans compounds this guilt.<sup>273</sup> Given the highly publicized Agent Orange litigation and legislation, the use of Agent Orange is now a highly salient issue.<sup>274</sup>

As with Chernobyl, the differences between Agent Orange and DUWs suggest that they should be treated differently. Agent Orange is an area weapon — in conflicts, it is often sprayed repeatedly in order to defoliate a large expanse of vegetation. DUWs, on the other hand, are directed weapons — troops aim them at a particular military object, like a tank. As a result, for civilians, the average dose of toxins from Agent Orange exposure is substantially higher than the average dose of toxins from DU exposure.

This focus on NGO-framing should not suggest that the military is incapable of using heuristics to counter-frame the debate. One could imagine a world in which availability errors weighed on both sides of a given issue.<sup>275</sup> States, however, generally prefer to portray themselves to their citizens as militarily secure and dominant. Even if the military wanted to argue for its dependence on a particular weapon, it is hard to imagine it successfully reframing the debate to make the possible losses in conflict salient and vivid. The public lacks knowledge of an incident in which weapons restrictions resulted in significant military losses. In addition, U.S. military lawyers seem reluctant to articulate the moral vision that informs their views about the laws of war, choosing instead to articulate technical, legal arguments and promote those interpretations that further U.S. interests.<sup>276</sup>

### B. Blame Attribution

Blame attribution is another cognitive bias that helps explain public calls for weapons regulation. Attribution theory is “a general conception

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note 60, at 249, 271.

<sup>272</sup> *Id.*

<sup>273</sup> *Id.*

<sup>274</sup> See PETER H. SCHUCK, *AGENT ORANGE ON TRIAL* 41-42 (1986).

<sup>275</sup> Adrian Vermeule & Eric Posner, *Accommodating Emergencies*, 56 STAN. L. REV. 605, 634-35 (2003).

<sup>276</sup> Kenneth Anderson, *The Role of the United States Military Lawyers in Projecting a Vision of the Laws of War*, 4 CHI. J. INT'L L. 443, 445 (2003).

of the way people think about and analyze cause-effect data."<sup>277</sup> Blame attribution, a bias identified by attribution theory, suggests that people desire to ascribe negative events to a human cause rather than to chance.<sup>278</sup> Blame attribution also suggests that when people suffer from unfamiliar health problems, they latch onto information about a new risk as evidence that this risk causes their maladies, rather than chance or older risks.<sup>279</sup>

Several factors increase the likelihood and intensity of blame attribution following conflict. First, the need to assign a cause for a serious illness is particularly strong compared to other cause-effect relationships.<sup>280</sup> Populations dealing with seemingly high frequencies of serious maladies want to ascribe causes for those illnesses. Second, attribution theory suggests that people care more about risks involuntarily imposed by other people than risks they undertake voluntarily.<sup>281</sup> The infliction of illness following conflict falls into this category — most civilians in a post-conflict zone can do little to avoid polluted air, food, and water, assuming they even know what areas are polluted. Similarly, soldiers exercise little control over their working conditions. Most people attribute even greater blame if the person thought to be imposing the risk draws some advantage from the imposition of the risk that is not shared with the sick population.<sup>282</sup> One can easily comprehend why a domestic population would readily blame foreign forces for the onset of new ailments and illnesses. Even the returning troops may see their country as subjecting its soldiers to heightened risks for which they received no obvious benefit.

The framing of the DUWs debate provides a good example of blame attribution at work. Various ailments plague both U.S. troops and Iraqi civilians in the wake of the first Gulf War. Birth defects, cancer, and other illnesses loosely categorized as Gulf War Syndrome currently affect

<sup>277</sup> Howard H. Kelley, *The Processes of Causal Attribution*, 28 AM. PSYCHOLOGIST 107, 107 (1973).

<sup>278</sup> TRAUMA CARE: A TEAM APPROACH 39 (Deborah Langstaff & Jane Christie eds., 2000).

<sup>279</sup> June Fessenden-Raden et al., *Providing Risk Information in Communities: Factors Influencing What Is Heard and Accepted*, 12 SCI. TECH. & HUM. VALUES 94, 95 (1987).

<sup>280</sup> Marsha Rosenthal & Mark Schlesinger, *Not Afraid to Blame: The Neglected Role of Blame Attribution in Medical Consumerism and Some Implications for Health Policy*, 80 MILBANK Q. 41, 46 (2002).

<sup>281</sup> T. R. Lee, *The Public's Perception of Risk and the Question of Irrationality*, 376 PROC. ROYAL SOC'Y LOND. 5, 13 (1981).

<sup>282</sup> *Id.*

130,000 members of the Armed Services.<sup>283</sup> Similarly, European peacekeepers deployed in the Balkans suffer from an unusually high incidence of cancer and other health abnormalities.<sup>284</sup> Preliminary reports of Gulf War Syndrome are emerging from the ongoing occupation of Iraq.<sup>285</sup> No scientific link between DU and Gulf War Syndrome has been established, but many have speculated on the relationship between the two.<sup>286</sup> Regardless of whether DU causes Gulf War Syndrome, DUW opponents can “piggyback” the DU issue on the highly visible health catastrophe of Gulf War Syndrome.<sup>287</sup>

### C. *Myopia to Old Risks*

In addition to the availability heuristic and blame attribution errors, the public often displays insensitivity to the presence of risks that have become part of the background and, thus, acceptable.<sup>288</sup> This distinction between old and new risks is a common one, and domestic regulation often treats the risks differently.<sup>289</sup> This distinction is sometimes justified — the transition costs away from a product or technology already in common use can often be high.<sup>290</sup> But the mere fact that a technology is old and commonly accepted does not mean that its risks are well-understood or that it poses lesser risks than newer technology.<sup>291</sup> Despite this, the public cares much more about unfamiliar risks even when the status quo presents statistically similar risks.<sup>292</sup>

The concern about DUWs displays a similar myopia to older risks in

<sup>283</sup> See Depleted Uranium Munitions Suspension and Study Act of 2001, H.R. 3155, 107th Cong. § 2(7) (2001), available at <http://www.idust.net/Docs/HR3155-2001.htm>. (relaying Congressional finding that at least 130,000 troops suffer from Gulf War Syndrome).

<sup>284</sup> See Edward J. Otten & Matthew D. Sztajnkrzyer, *Chemical and Radiological Toxicology of Depleted Uranium*, 169 MIL. MED. 212, 212 (2004) (discussing Balkans Syndrome).

<sup>285</sup> Stan Goff, *Gulf War Syndrome? Military Equipment and “Pneumonia,”* COUNTERPUNCH Aug. 5, 2003, <http://www.counterpunch.org>; Steve Rosenfield, *Gulf War Syndrome II* (Apr. 9, 2003), <http://www.alternet.org/story/15590>.

<sup>286</sup> Augst, *supra* note 130; Goff, *supra* note 285.

<sup>287</sup> See Roger G. Noll & James E. Krier, *Some Implications of Cognitive Psychology for Risk Regulation*, in BEHAVIORAL LAW AND ECONOMICS, *supra* note 249, at 325, 344.

<sup>288</sup> See generally Huber, *supra* note 65 (identifying myopia to old risks as pervasive regulatory problem).

<sup>289</sup> *Id.*

<sup>290</sup> *Id.* at 1064.

<sup>291</sup> *Id.* at 1052.

<sup>292</sup> PAUL SLOVIC, *THE PERCEPTION OF RISK* 140-43 (2000); see SUNSTEIN, *supra* note 64, at 27-28.

the military context. For instance, after deploying DUWs and DU tank armor, the DOD developed guidelines to advise field commanders on appropriate levels of radiation risk based on the risks and importance of a particular mission. Meanwhile, the DOD has not developed comparable guidelines for lead exposure,<sup>293</sup> which presents similar risks to military personnel. In addition, every international weapon ban, with the exception of the landmine treaty,<sup>294</sup> has been of a newly developed weapon. This myopia to older risks helps explain why health and environmental advocates push for the application of the precautionary principle to DUWs, but not to older weapons like tungsten ammunition.

*D. Broader Implications: Dejustifying a Military Precautionary Principle*

Thus far, this paper has demonstrated that the precautionary principle's application to DUWs might not improve environmental and health conditions. Given the likely weapon substitutes, a DUWs ban may even increase the risks to civilian populations. Similarly, total remediation may cause more damage to the environment than merely abandoning the contaminated sites will. Even if the precautionary principle gets it wrong for DUWs, the existence of one false positive (regulating a de minimus harm) or one negative unintended consequence (increasing a separate risk)<sup>295</sup> alone does not disprove the general justification for expanding the precautionary principle to wartime. Thus, this section provides a broader critique of the military precautionary principle by explaining why the justifications for a domestic precautionary principle do not apply in the military context, illuminating why errors present in the DUWs example are likely systematic, and identifying the likely negative consequences of a military precautionary principle.

Many of the general concerns about domestic environmental

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<sup>293</sup> UNITED STATES ARMY CTR. FOR HEALTH PROMOTION & PREVENTATIVE MED., MISSION AREA GUIDE TO LEAD EXPOSURE CONTROL 15 (1996), available at <http://www.aepi.army.mil/internet/mission-area-guide-lead-exposure.pdf>.

<sup>294</sup> Even landmines provide an interesting case. The ban movement was stimulated in part by the development of undetectable, low-metal mines.

<sup>295</sup> It is a truism that the precautionary principle incurs the harms of overreacting to false positives (risks thought to be serious that turn out to be minor), while cost-benefit analysis incurs the harms of false negatives (risks thought to be minor that turn out to be serious). Cross, *supra* note 61, at 851; Jonathan B. Wiener, *Whose Precaution After All? A Comment on the Comparison and Evolution of Risk Regulatory Systems*, 13 DUKE J. COMP. & INT'L L. 207, 224 (2003).

underregulation translate awkwardly into the weapons setting. For instance, while most environmental regulations balance immediate short-term economic costs with uncertain, long-term environmental losses, the military context adds an additional level of complexity. In addition to weighing economic and environmental costs, additional costs, like protecting soldiers and shortening conflicts, are also relevant. Those military costs, important in their own right, affect the environmental and health calculations. For instance, a longer war fought with less effective weapons creates its own risks to the environment and civilians. While the public may generally overvalue immediate economic costs, the existing literature does not suggest that the public overvalues military costs.<sup>296</sup>

The democratic impulses that animate the precautionary principle also make less sense in the weapons context. Defenders of the precautionary principle often view its application as a way to allow citizens more control over the toxins in their own environment.<sup>297</sup> While the justifications for and benefits of more direct public involvement in domestic risk assessment are debatable, these rationales do not support democratizing science in the military context. A long history of deference suggests that giving freedom to the military to make decisions about a core issue such as weaponry would be appropriate.<sup>298</sup> In fairness, the military admittedly lacks special expertise in toxicology or risk assessment. Even so, only the military possesses the competence to make the comparisons of efficiency among weapons and to assess how weapon choices affect given conflicts.

Certain heuristics and biases also seem especially prevalent in the context of international weapons regulation. This Article has already identified three likely problems: the availability heuristic, blame attribution errors, and myopia to old risks. Such systematic errors suggest that decision-makers should be wary of a weapons ban justified by a strong version of the precautionary principle. In addition, this

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<sup>296</sup> This insensitivity to military costs might be attributed to the timing of movements to ban weapons. The ban or regulation usually takes place during a period after conflict, so there is no sense of an impending military cost — only a restriction for future hypothetical conflicts. Michael N. Schmitt, *Bellum Americanum: The U.S. View of Twenty-First Century War and Its Possible Implications for the Law of Armed Conflict*, in *THE LAW OF ARMED CONFLICT INTO THE NEXT MILLENNIUM* 389, 389 (Michael N. Schmitt & Leslie C. Green eds., 1998).

<sup>297</sup> Adelman, *supra* note 8, at 563.

<sup>298</sup> But see Jonathan Masur, *A Hard Look or a Blind Eye: Administrative Law and Military Deference*, 56 *HASTINGS L.J.* 441 (2005).

section suggests two broader problems with the application of the precautionary principle in wartime: poor environmental prioritization and systematic bias.

The use of cognitive biases by NGOs to mobilize the public provides a reason to be suspicious about the environmental priorities set by the precautionary principle's application.<sup>299</sup> As explained earlier, the salience of a given harm has no intrinsic relation to its probable magnitude or likelihood of creating a negative environmental or health impact.<sup>300</sup> Yet, the most salient harms often dominate regulatory attention. In a world with finite military budgets and limited political will, environmental prioritization matters, so the public's skill in setting the regulatory agenda counts a great deal.

It is beyond the scope of this Article to discuss all the alternative proposals to protect the environment and civilians during wartime. It is worth noting, however, that many other worthwhile demands for resources and legal attention exist. As explained earlier, a division exists within the legal community over whether to promote compliance with existing agreements and recruit new members or to further develop the laws of war principles by importing peacetime principles. Extending the precautionary principle to the military context and demanding that governments apply it on a weapon-by-weapon basis trades off with other approaches such as more thorough environmental impact analysis for all weapons,<sup>301</sup> increased funding for remediation in situations where greater certainty about the probability and magnitude of the harm exists,<sup>302</sup> and the prosecution of environmental war crimes.<sup>303</sup>

A military precautionary principle also systematically disfavors new war-fighting technology. This paper suggests that states lacking military resources should generally prefer a focus on the long-term potential environmental and health effects of weapons, because it disadvantages wealthy states with the resources to devote to technological arms change.<sup>304</sup> Rationalist accounts of arms control bolster this supposition

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<sup>299</sup> Cross, *supra* note 61, at 909-14.

<sup>300</sup> *Supra* Part IV.A.

<sup>301</sup> Hourcle, *supra* note 1, at 692.

<sup>302</sup> Austin & Bruch, *supra* note 171, at 42.

<sup>303</sup> Mark J.T. Caggiano, Comment, *The Legitimacy of Environmental Destruction in Modern Warfare: Customary Substance Over Conventional Form*, 20 B.C. ENVTL. AFF. L. REV. 479, 505 (1993).

<sup>304</sup> One might argue that the precautionary principle would cut in both directions since wealthy states also have a greater ability to innovate and reset the environmental baseline. Yet, as argued above, the old/new selectivity problem suggests that weapons restrictions



by suggesting that self-interest, rather than humanitarian impulses, drives states to pursue weapons restrictions.<sup>305</sup> Under such accounts, poor states try to limit the use of weapons that only wealthy states can afford and wealthy states try to limit the use of weapons that allow poorer states to exact tributes from wealthier states.<sup>306</sup> Much empirical evidence confirms this view — from the cross-bow, to nuclear weapons, to chemical weapons, to DUWs, poorer states have embraced claims of these weapons' unnecessary cruelty in order to limit their potential foes' use of these weapons.<sup>307</sup> Similarly, a military precautionary principle allows poorer states, concerned about their self-interests, and NGOs, concerned about environmental and health harms, to form a coalition to push for individual weapons bans.

Such systematic bias may not be an inherent problem on fairness grounds,<sup>308</sup> but it risks some troubling outcomes. Widespread noncompliance with treaty bans presents one worrying possibility. Advocating the precautionary principle in domestic law is different than advocating its incorporation into international law. Wealthy states can refuse to join treaty regimes or breach their treaty obligations with little fear of international sanctions. In particular, the United States often stays outside of or withdraws from treaty regimes it finds not to be in its interest.<sup>309</sup>

Compliance, however, may be a surmountable problem. It was once accepted as axiomatic truth that only ineffective weapons would be subject to international restrictions,<sup>310</sup> but recent history suggests that weapon bans premised on protecting civilians have a good chance of becoming international law.<sup>311</sup> Even rationalist explanations of weapons

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are much more likely to cover new rather than old weapons.

<sup>305</sup> Eric A. Posner, *A Theory of the Laws of War*, 70 U. CHI. L. REV. 297, 300 (2003).

<sup>306</sup> *Id.* at 305-07.

<sup>307</sup> See Christopher Greenwood, *The Law of Weaponry*, in *THE LAW OF ARMED CONFLICT INTO THE NEXT MILLENNIUM*, *supra* note 296, at 185, 191; Richard Price, *A Genealogy of the Chemical Weapons Taboo*, 49 INT'L ORG. 73, 90, 96 (1995).

<sup>308</sup> See generally THOMAS FRANCK, *FAIRNESS IN INTERNATIONAL LAW AND INSTITUTIONS* 18-22 (1995) (discussing widespread belief in maximin principle which permits unequal treatment of states if it benefits those worst off).

<sup>309</sup> Brunnee, *supra* note 168, at 618-19.

<sup>310</sup> See Price, *supra* note 307, at 82 (discussing "widespread conviction of the futility of limitations on effective weapons").

<sup>311</sup> Norms involving the "prevention of bodily harm for vulnerable or innocent groups" are likely to be effective domestically and abroad. Beth A. Simmons, *Compliance with International Agreements*, 1 ANN. REV. POL. SCI. 75, 87 (1998). Moreover, as political scientist Ethan Nadelmann argues, norms are likely to evolve into global prohibition regimes when:

bans leave some room for prohibitions that tap into the heuristics and biases of the public.<sup>312</sup> Moreover, although the United States might refuse to join a DUWs ban treaty, it might still accede to the norm against their use.<sup>313</sup> For instance, the United States might adopt a nonbinding moratorium on DUWs while it continues to study the DUWs problem and develop alternatives to them.

If the compliance problem is overcome, then the military precautionary principle still presents a second troubling outcome. A strong version of the precautionary principle operates to freeze the status quo. It prevents the deployment of new weapons until the government can demonstrate their safety.<sup>314</sup> Such an outcome might initially seem desirable, but the U.S. military generally designs new weaponry to minimize both civilian and military losses.<sup>315</sup> Smart technology helps reduce civilian casualties,<sup>316</sup> but efforts to prove that weapons derived from such technology have no secondary environmental effects could keep them off the battlefield. Moreover, knowledge that new weapons would have to comply with a strong version of the precautionary principle may prevent states from investing in such advancements in the first place.

#### V. AN ALTERNATIVE APPROACH TO UNCERTAINTY

The military context requires an alternative approach to the problem of scientific uncertainty. This proposal aims to capture the benefits of a systematic method to uncertainty while generating better outcomes than the precautionary principle provides. This alternative is designed to be

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(1) they are already criminalized in dominant countries, (2) they target an activity that crosses borders, and (3) the activity is tied to a norm that relates to the ways in which individual human beings are treated both by states and by one another. Ethan A. Nadelmann, *Global Prohibition Regimes: The Evolution of Norms in International Society*, 44 INT'L ORG. 479, 524 (1990); see Price, *supra* note 307 at 83 (explaining that chemical weapons taboo arose from linkage of chemical weapon use to civilian harm).

<sup>312</sup> This includes those weapons bans that are based on "deep-seated taboos." Posner, *supra* note 305, at 300.

<sup>313</sup> Norms against particular weapons with deep public support may constrain state behavior even if states choose not to join a treaty regime. Lesley Wexler, *The International Deployment of Shame, Second-Best Responses, and Norm Entrepreneurship: The Campaign to Ban Landmines and the Landmine Ban Treaty Treaty*, 20 ARIZ. J. INT'L & COMP. L. 561 (2003).

<sup>314</sup> SUNSTEIN, *supra* note 64, at 35; Jonathan H. Adler, *Dangerous Precaution*, NAT'L REV., Sept. 13, 2002, available at <http://www.nationalreview.com/adler/adler091302.asp>.

<sup>315</sup> FRANÇOIS HEISBOURG, WARFARE 11 (1997).

<sup>316</sup> *Id.* at 44.

both technology-forcing and information-forcing. As such, the proposal seeks the development and use of cleaner weapons as well as the provision of information about possible environmental and health consequences. Successful promotion of these values should encourage the government to remove or retool weapons in its arsenal as new information becomes available. It also provides some transparency to this process in order to promote good faith information reporting.

This Article proposes an amendment to article 36 of the 1977 Geneva Protocol I to serve as an alternative to the use of the precautionary principle. Article 36 currently requires member states to determine whether a new weapon complies with Geneva Protocol I and international law more generally. The proposed amendment adds to the current article 36 obligations by: (1) changing the compliance determination to an ongoing duty, (2) providing guidance on the appropriate studies needed to make compliance determinations, and (3) requiring transparency of the compliance reviews once the weapon has been used in combat.<sup>317</sup> The expectation is not that many weapons will be banned at some future point, but that better information about weapons' toxic properties will influence decision-making about appropriate weapon choices.

If the international community lacks the political will for an amendment,<sup>318</sup> the substance of this proposal can also be implemented as purely domestic law. In addition, the required reporting can be integrated into domestic systems — the Environmental Protection Agency ("EPA") is currently creating a unified database for all existing

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<sup>317</sup> Such an obligation might be amended in the following manner:

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under a *continuing* obligation to determine whether its employment would, in some or all circumstances, be prohibited by any other rule of international law applicable to the High Contracting Party. *The High Contracting Party shall submit a report on its findings and shall report the findings publicly once the weapon has been employed. Such reports shall be based on scientifically reliable studies and access to such studies shall also be made publicly available.*

ROBERTS & GUELFF, *supra* note 93, at 442 (suggested changes to article 36 in italics).

<sup>318</sup> It is worth noting that many states do not comply with reporting commitments under human rights treaties. On the other hand, states comply somewhat more with reporting commitments under arms controls treaties. Enforcement is even a problem in domestic reporting systems. The United States is both generally compliant with its international reporting commitments and often at the forefront of weapons developments.

and future environmental reporting.<sup>319</sup> If other countries agreed to the amended article 36, a global information registry could be created using the Internet.<sup>320</sup> Such a registry would ease the costs of information sharing for the exposures and possible doses of toxic releases. A uniform reporting format allows for better and quicker aggregation and comparison of data by both governments and NGOs.<sup>321</sup> Internet-based reporting requirements also avoid the costs associated with paper systems and make the information more accessible to the public.

By forcing a widescreen view of all weapons, this approach also frees up NGOs to perform monitoring functions by obviating their current agenda-setting role. In other words, NGOs would no longer need to promote more stringent environmental reviews for new weapons. Instead, NGOs could devote more of their resources to ensure states comply with article 36's requirements. Naming and shaming countries that fail to comply with international law is one of their traditional roles.<sup>322</sup> NGOs have also traditionally helped interested parties consume government information by putting it into more accessible language and locations.<sup>323</sup>

#### A. Comparison of Systems

##### 1. Agent Orange

A brief comparison of the status quo, the precautionary principle, and the proposed amendment to article 36 helps illuminate the differences between these approaches. Agent Orange, a hard case, highlights the difficulties of coping with uncertainty. To begin with, in 1961, using

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<sup>319</sup> See U.S. Env'tl. Prot. Agency, Off. of Env'tl. Info., <http://www.epa.gov/oei/> (last visited Dec. 10, 2005).

<sup>320</sup> See, e.g., Such an international information registry is not unprecedented. See U.N. REGISTER OF CONVENTIONAL ARMS, available at <http://disarmament.un.org/cab/register.html> (last visited Jan. 11, 2005).

<sup>321</sup> Bradley C. Karkainen, *Information as Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm*, 89 GEO. L.J. 257, 286-87, 348 (2001) (recognizing that many other countries have begun modeling inventories based on United States's Toxic Release Inventory, so they have familiarity and may have some innovations of their own to offer).

<sup>322</sup> Wexler, *supra* note 313, at 572.

<sup>323</sup> Ronald B. Mitchell, *Sources of Transparency: Information Systems in International Regimes*, 42 INT'L STUD. Q. 109, 122-23 (1998).

something like the status quo article 36 requirements,<sup>324</sup> the United States determined that Agent Orange complied with international law requirements. No domestic legal requirements or suggestions about appropriate scientific studies guided the government's determination. The 1961 review does not mention what, if any, studies were consulted or conducted. After the initial determination, no ongoing duty to assess the weapon's legality attached.<sup>325</sup> It was not until the Agent Orange Act of 1991<sup>326</sup> that the government asked the Institute of Medicine to review existing evidence about Agent Orange's harm to veterans. Congress also asked the Institute to consider the feasibility of further epidemiological studies, as neither the United States nor Vietnam had ever conducted a large scale epidemiological study of the Vietnamese population.<sup>327</sup>

It is difficult to know exactly how the precautionary principle would have grappled with the use of defoliants in Vietnam. Under a weak version of the precautionary principle like the Rio Declaration, the United States would have been compelled to take cost-effective measures to prevent environmental degradation once a threat of serious or irreversible damage had been posited. Such a principle places no duty on the government to determine if a threat exists, but only requires the government to take cost-effective remedies once such a threat is revealed. Given defoliants' long latency period, the necessary threat of serious or irreversible harm would have taken years to appear and such a principle would likely have done nothing to prevent the use of defoliants in Vietnam. The precautionary principle may, however, have required cost-effective remediation.

A stronger version, like the Wingspread Statement, would not have required any threshold-level showing of harm to trigger its obligations.<sup>328</sup> Instead, the United States would have been under a burden of proof to

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<sup>324</sup> The requirements of Geneva Protocol I did not come into force until 1978. Protocol I, *supra* note 112. The United States, however, conducted similar determinations of international compliance prior to adoption of Geneva Protocol I. Memorandum from Dean Rusk, Secretary of State, to President John F. Kennedy (Nov. 24, 1961), *reprinted in* 1 FOREIGN RELATIONS OF THE UNITED STATES 1961-1963, at 663, *available at* [http://www.state.gov/www/about\\_state/history/vol\\_i\\_1961/z.html](http://www.state.gov/www/about_state/history/vol_i_1961/z.html) (Item 275); *see also In re Agent Orange Prod. Liab. Litig.*, 373 F. Supp. 2d 7 (E.D.N.Y. 2005).

<sup>325</sup> The United States has not used defoliants like Agent Orange since Vietnam. President Ford issued Executive Order No. 11,850 on April 8, 1975 renouncing the first use of herbicides in war, except in certain limited circumstances. Exec. Order No. 11,850, 40 Fed. Reg. 16,187 (1975).

<sup>326</sup> Pub. L. No. 102-4, 105 Stat. 111 (codified as amended at 38 U.S.C.A. § 1116 (2002)).

<sup>327</sup> *In re Agent Orange*, 373 F. Supp. 2d at 16.

<sup>328</sup> *See supra* note 10.

demonstrate the safety of defoliants before they were used in combat. Even if the relationship between defoliants and health harms like cancer were not conclusively shown, the government would have been under an obligation to take precautionary measures. This may be consistent with actual United States practice, which limits the use of herbicides as defoliants and forbids their use as chemical warfare against the military or civilians. Perhaps the Wingspread Statement would have also required that protective gear and warnings be provided to civilians. Again, it is difficult to see how this version of the precautionary principle would have addressed the lengthy latency period of the cancers caused by defoliants.

The strongest versions of the precautionary principle would have prohibited the use of defoliants unless the United States proved the absence of the requisite level of harm. It is difficult to imagine what proof would be acceptable. Even if tests available at the time could have quantified the harms of defoliants, such harms would not have been compared to the harms presented by alternatives nor would they have been balanced with the relevant military costs. For example, the Rome plough, an alternative mechanism to clear land is thought to cause serious ecological disruptions and impede future agricultural efforts.<sup>329</sup>

Finally, under the proposed amendment to article 36, the United States would have been under an ongoing duty to determine the legality of Agent Orange even after it had first been used in combat. The initial determination would have been guided by the commentary on scientifically appropriate studies. Given the paucity of information at the time, defoliants probably would have been allowed. As the Vietnam War continued and the health harms became more visible, however, the ongoing duty would have required new studies that accounted for the practices on the ground and improved knowledge about the relationship between defoliants and health harms. The ongoing reviews would have compared Agent Orange to other defoliants that were less widely used but presented a greater health hazard and then also compared it to the alternative weapons or strategies that would have been employed in Agent Orange's absence.

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<sup>329</sup> Larry Lohman, *Forestry, Politics and Violent Conflict*, in *ECOLOGY AND VIOLENT CONFLICT* (Mohamed Suliman ed., 1999), available at <http://www.thecornerhouse.org.uk/item.shtml?x=52209> (describing the Rome plough as "a heavy Caterpillar tractor equipped with a large blade designed to split, sever, fell and push aside trees of all sizes" and as being responsible for immense soil erosion and wildlife loss in Vietnam).

## 2. Lead Bullets

Lead bullets provide another example of the difficulties of regulating the unintended environmental consequences of weapons. The U.S. military has long relied on lead bullets. So far, NGOs and the public at large voice little concern about the impact of lead bullets on the environment or civilian populations, although a few have suggested that lead buckshot presents a nontrivial risk to waterfowl and other species. Thus far, no one contends that lead bullets violate the laws of war.

Yet given lead's high toxicity, the lack of general concern suggests a myopia to older, background risks. After witnessing the consequences of lead paint on children, the EPA heavily regulated most domestic lead exposure. The military, however, did not face such stringent regulations. But as civilians living near the military testing ranges complained of statistically unusual illnesses, the government and the military grew concerned that the numerous toxins present on testing grounds were seeping into the neighboring air and water supplies.

In the mid-1990s, the EPA expressed concern over civilian and environmental exposure to a variety of munition-related chemicals, including the lead from bullets. In 1997, the EPA used the Safe Water Drinking Act to call a ceasefire at Camp Edwards, a military testing range.<sup>330</sup> In particular, the ceasefire prohibited the use of lead bullets at the facility and hastened the military's ongoing development of "green ammunition."<sup>331</sup> The military then settled on tungsten bullets, which were thought to be nontoxic and insoluble, meaning that they would not leach into the soil. As it experienced initial success in developing and testing green ammunition, the army announced plans to replace all lead bullets, including those used abroad, with green bullets.

Some military advocates opposed the use of green bullets on a variety of efficiency grounds. To begin with, tungsten bullets cost several cents more per bullet to produce and, as mentioned earlier, the tungsten must be imported from China. The critics also claimed that green bullets lack the lethality of lead bullets. If green bullets wear down guns faster because they require repeated firings to achieve the same lethality as lead bullets, they will also require an increased investment in

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<sup>330</sup> Amanda Lehmert, *Unfriendly Fire: Army's New Green Ammunition May Pose Health Hazards Too*, CAPE COD TIMES, June 29, 2004, available at [http://www.familiesagainstcancer.org/update\\_archive/php](http://www.familiesagainstcancer.org/update_archive/php).

<sup>331</sup> The military began developing green ammunition in 1994. *Id.*

replacement weapons. The military countered these claims by suggesting that refinements in tungsten bullets would whittle down any difference in effectiveness. The military also suggested that the savings from no longer having to clean up lead bullet sites would offset tungsten bullets' initial higher price. The verdict is still out on this military utility and cost debate.

When the military began its transition to green bullets, tungsten seemed relatively safe. This assumption of safety, however, rested on an absence of research on tungsten's possible toxic effects. Recent scientific studies suggest tungsten may be seriously chemically toxic and carcinogenic. In addition, tungsten may increase lead's ability to travel through soil. Limited environmental evidence suggests tungsten possesses a "strong toxic effect on soil microbial community, soil microfauna, and plant growth."<sup>332</sup>

The U.S. military's experience with lead bullets suggests some difficult lessons. On the positive side, the military's research into alternative bullets began prior to the ceasefire. This suggests that the military has some independent interest in developing greener weapons. Yet the EPA's ban, an embodiment of one of the variations on the precautionary principle, demonstrates the danger of weapons bans in the face of limited evidence about the environmental effects of alternatives. The ongoing lead bullet ban forces those at the Camp Edwards range to either give up live firing exercises, which seems unlikely, or use the potentially more dangerous tungsten bullets while the military develops a new alternative.

### B. Ongoing Duty

Such a brief sketch of the comparisons between the status quo, the military precautionary principle, and the new alternative must be accompanied by a more thorough understanding of how an amended article 36 would work. This amendment creates opportunities to learn from previous errors, integrate new information, and respond to changing conditions.<sup>333</sup> It forces weapons to be evaluated in the context of changed scientific understandings and advances in screening and testing. In such a situation, an ongoing duty obligates governments to

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<sup>332</sup> Nikolay Strigul et al., Speech at Annual International Conference on Soils, Sediments, and Water: Tungsten Effects on Soil Visited Environment (Oct. 19, 2004), available at <http://www.umasssoils.com/abstracts2004/Tuesday/trainingranges.htm>.

<sup>333</sup> Karkainen, *supra* note 321, at 277.



reevaluate their weapons in a way that promotes the reduction of uncertainty.<sup>334</sup> An ongoing duty also accounts for the long latency period of many diseases by allowing the existence of health and environmental problems that develop years after a conflict to influence the legality determination. Such an obligation warns militaries that even weapons that have been used in battle may be subject to removal from their arsenals.

The ongoing duty needs to be crafted in such a way as to combat the existing disincentives to produce information about environmental and health harms.<sup>335</sup> Absent a law or norm detailing expectations about weapons reviews, states have little reason to produce quality information about the harms that their weapons produce, as they fear increased regulation, heightened scrutiny, and possible litigation.<sup>336</sup> Yet states and weapons manufacturers are in the best position to produce this information — they have knowledge gained from their exposed workers and communities.

The domestic implementing legislation can help create incentives for information disclosure. Penalty schemes present one such option.<sup>337</sup> For instance, companies can be fined or otherwise sanctioned for the failure of “good faith” production of information needed for a weapons review. Similarly, regulations can reward companies for producing requested information, completing scientific studies, and being proactive in developing toxicology tests. The fear of litigation that often encourages silence in the face of such information may be lessened in the military context, as the *Feres* doctrine generally bars domestic litigation by soldiers<sup>338</sup> and the United States is increasingly unwilling to submit to international litigation. Domestic litigation for families of soldiers and foreign nationals presents a real concern, but relevant parties would have to show the weapon’s use violated international law at the time of use rather than showing that it violated later understandings.

By creating an ongoing but nonretroactive duty, the proposed

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<sup>334</sup> Mary L. Lyndon, *Information Economics and Chemical Toxicity: Designing Laws to Produce and Use Data*, 87 MICH. L. REV. 1795, 1797 (1989).

<sup>335</sup> See, e.g., Wagner, *supra* note 16, at 1641.

<sup>336</sup> Just as companies have little incentive to produce information about the harms of their products despite potential damage to their own employees and relationship with the community, states have little incentive to produce information despite potential harm to their own soldiers and relations with countries they occupy.

<sup>337</sup> Cary Coglianese, Richard Zechauser & Edward Parson, *Seeking Truth for Power: Informational Strategy and Regulatory Policymaking*, 89 MINN. L. REV. 277, 301 (2004).

<sup>338</sup> *Feres v. United States*, 340 U.S. 135, 145 (1950).

amendment raises the problem of myopia to older risks. Excluding weapons already in the arsenal may exacerbate a myopia to old risks and encourage countries to hold on to dirty weapons in fear that new weapons will not meet the future, more stringent ongoing review. On the other hand, including all older weapons would be prohibitively costly. For instance, the United States possesses a multitude of different weapons, only a few of which are thought to cause unintended health harms to civilians or environmental harms. Examining every weapon in the arsenal would also engender much hostility from those in charge of compliance programs. In order to combat these problems, weapons reviews ought to include a comparison to likely alternatives. For example, while the ongoing duty does not require an independent review of tungsten ammunition, the DUWs review should necessarily include a discussion of tungsten ammunition and note the areas of needed further research.

Domestic regulation also suggests focusing on the most worrisome toxic substances and then regulating those activities and products with the most dangerous concentrations.<sup>339</sup> Using priorities established by domestic regulation, implementing legislation to an amended article 36 could create an independent civilian review board to identify those weapons most in need of review. Second, the choice between a weapon-by-weapon review and the evaluation of a class of similarly situated weapons presents another decision. It is worth noting that there can be substantial differences within a similar class of weapons. For example, the toxicity of herbicides vastly differ.<sup>340</sup> Agent Purple, the first herbicide sprayed in Vietnam, has substantially more dioxin than other herbicides. Conversely, Agent White contains no dioxin. A class-wide determination loses sight of these important differences. For example, if the real concern about DU is its heavy metal content, then we need to compare weapons across their metal contents rather than their nuclear contents.

Similarly, careful attention needs to be paid to the mechanism that triggers the ongoing duty. Several possibilities arise. First, an ongoing duty might require a weapons review at regular intervals. The reports could accompany the existing review conferences to laws of war treaties. Such an interpretation routinizes review and forces frequent updating of

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<sup>339</sup> John C. Dernbach, 21 HARV. ENVTL. L. REV. 1, 81 (1997) (discussing proposed domestic reform).

<sup>340</sup> *In re Agent Orange Prod. Liab. Litig.*, 373 F. Supp. 2d 7, 19-20 (E.D.N.Y. 2005).

information. It may, however, overly burden states while producing limited benefits. Reviewing the safety of newly developed weapons every five or ten years may be unnecessary, especially for those states enjoying an absence of conflict.

An ongoing duty might instead be akin to the duty to supplement evidence in domestic civil litigation. As governments become aware of new information about a weapon, they should be required to include such information in their next assessment of the weapon. Such an interpretation only compels states to reveal information rather than to develop it. If external forces encourage a state or other entity to conduct reliable studies, such an interpretation may produce the desired result. On the other hand, it may be insufficiently information-forcing if the government has the only or even just the best access to the information needed for new studies.

An alternate formulation allows other states to file a petition for review of a particular weapon. A standing requirement may overly politicize the process or unjustly exclude those unable to show harm. Instead, the petition process could mimic the call for meetings under article 7 of Geneva Protocol I. Article 7 allows any of the High Contracting Parties to call for a meeting, but still requires the approval of the majority of the High Contracting Parties to convene the meeting. Such a reporting mechanism forces states to actively acquire new information about weapons and disclose reports, but only when a majority of state parties think it is desirable. This interpretation loses the benefits of studying those weapons that are “under the radar,” but it does preclude a state from doing nothing on those weapons that are of great concern. This proposal may still be vulnerable to the criticism about heuristics, so we might worry that states will only call for reviews of visible, contentious weapons, rather than those that scientists suggests are causing the most harm.

### C. Scientific Guidelines

Article 36 currently lacks guidelines on the necessary scientific studies and information needed to conduct weapons reviews. The proposed commentary to article 36 might include a nonexhaustive range of appropriate methodologies and scientific protocols. A flexible standard allows for a wide but not unlimited range of studies. These tests might seek to find the immediate harms of exposure and the harms of long-term, low-level exposures.

Drawing on domestic analogues, the landmark *Daubert v. Merrell Dow*

*Pharmaceuticals, Inc.*<sup>341</sup> suggests some factors that could help determine scientific validity of the reasoning or methodology underlying the reports. In determining the admissibility of scientific expert testimony, *Daubert* asks whether the scientific method employed is reliable and whether the method has been reliably applied. Factors that help guide the admissibility determination include whether expert evidence: (1) can be tested, (2) has been subjected to peer review and publication, (3) has been generally accepted in the scientific community, and (4) has a known or potential rate of error.<sup>342</sup> Under *Daubert*, the methodology must be supported by more than mere speculation, although it allows for uncertainty. For example, many domestic agencies require animal testing prior to the release of products.<sup>343</sup> The methodology underlying toxicological animal tests is generally well-respected within the scientific community and the experiments can be replicated. So, at the very least, weapons reviews should include this type of basic test.

Unlike *Daubert*, however, article 36 lacks a gatekeeper to determine the scientific reliability of the studies used to compile the reports. First, states seem unlikely to agree to such a process. Moreover, gatekeepers run the risk of delay or politicization.<sup>344</sup> A board member with a political agenda could demand unattainable evidence in order to embarrass a state or highlight the absence of doubt when no real consensus is possible. Rather than use gatekeepers, amended article 36 should merely contain informative language and commentary that suggests appropriate scientific studies and protocols. The states and their agencies conducting the review will be left to make their own determinations about whether the evidence satisfies international law requirements. Even so, the commentary to article 36 provides a helpful baseline for NGOs and other actors to evaluate the content of the reports and critique those that fail to satisfy its requirements.

The commentary about appropriate studies also reinforces the ongoing nature of the state's duty. For instance, while some tests and methodologies may be novel or unavailable at the time of the first review, the ongoing nature of the duty provides some corrective as the

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<sup>341</sup> 509 U.S. 579, 589-90 (1993).

<sup>342</sup> *Id.*

<sup>343</sup> Megan Erin Gallagher, *Toxicity Testing Requirements, Methods and Proposed Alternatives*, 26 ENVIRONS ENVTL. L. & POL'Y. J. 253, 255 (2003).

<sup>344</sup> Wendy Wagner, *Congress, Science, and Environmental Policy*, 1999 U. ILL. L. REV. 181, 230.

methodologies may become relevant for later reviews. Similarly, epidemiological studies that are impossible to conduct when the weapon is first developed can be conducted after the weapon is used in conflict. Such studies may be conducted on our own forces and, with agreement from another country, on the relevant civilians.<sup>345</sup>

These compliance studies need to expand their focus to include an assessment of all the relevant harms — the environment, civilians, and military personnel. For instance, such a framework needs to confront the problems of synergistic and noncarcinogenic harms — harms probably not contemplated by the 1977 Geneva Protocol I.<sup>346</sup> Admittedly, attempts to cope with synergy exponentially increase the scientific burdens placed on a state. Rather than looking at whether one aspect of a weapon's chemistry causes harm, taking synergy seriously requires evaluating complex interactions among a weapon's given properties as well as the other properties in the environment. For example, a given chemical might produce a limited amount of harm at a given release, but the same chemical at the same release would produce a nonlinearly higher harm when combined with a second chemical. Similarly, scientists have a limited understanding of how toxic systems create negative reproductive, neurological, hormonal, and developmental effects.<sup>347</sup> Yet, some testing exists to determine these effects. A flexible rule would allow for the changes in scientific understanding to influence the direction of legal determinations and encourage greater information gathering about these less understood harms.

#### D. Transparency

In requiring states to make their reports and studies publicly available, amended article 36 attempts to balance transparency with military preparedness concerns. In this instance, transparency serves two related goals: it allows scrutiny of the state's decisions and improves information dissemination by facilitating cooperation and information-sharing with other states. Yet, by postponing transparency until after a weapon's first use, the amendment protects a state's strategic interests in

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<sup>345</sup> See, e.g., Memorandum of Understanding Between Vietnam and United States (Mar. 10, 2002), available at <http://www.niehs.nih.gov/external/usvcrp/mou31002.pdf>.

<sup>346</sup> This problem is certainly not limited to regulations in the wartime context — most domestic regulations ignore the synergistic and noncarcinogenic effects of pollutants. Karkainen, *supra* note 321, at 334.

<sup>347</sup> Wagner, *supra* note 16, at 1626.

new weapon development.

Many government actors, particularly the military, have resisted efforts to promote transparency.<sup>348</sup> After a weapon's first use, however, militaries may demonstrate significantly less hostility to the publicity of reports and studies that are similar to the paperwork required by an administrative review. Specificity about the types of studies and content of the reports expected also makes it more difficult for the military to duck its burdens.

For information dissemination to successfully cut against the heuristics and biases identified earlier, there must be government credibility and well-executed risk communication. Public distrust of the organization providing the information hurts efforts at risk management.<sup>349</sup> Thus, governments need to undertake the compliance reviews in a timely and good faith fashion — people are more likely to trust the information if it is delivered willingly and in response to new concerns.<sup>350</sup> In disseminating the information, the government also needs to account for the values that drive people's fears, as a purely technical analysis only exacerbates distrust.<sup>351</sup> The reports and studies ought to disclose the underlying principles and assumptions that undergird the studies and the reports' conclusions. A poorly executed information registry may inflame public passions and result in public pressure to eliminate the wrong weapons.<sup>352</sup> The government can use risk communication specialists to help present the information in ways that would best avoid the public's inherent cognitive biases and in a uniform manner that would facilitate comparisons across weapon systems.

#### CONCLUSION

How should states approach the uncertain health and environmental

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<sup>348</sup> Mark Fenster, *The Opacity of Transparency* 17-18 (Mar. 15, 2005) (unpublished manuscript), available at <http://ssrn.com/abstract=686998> (illustrating that military was able to secure exemption to Freedom of Information Act).

<sup>349</sup> Howard Kunreuther & Paul Slovic, *Science, Values, and Risk*, ANNALS AM. ACAD. POL. & SOC. SCI., May 1996, at 116, 117.

<sup>350</sup> Fessenden-Raden et al., *supra* note 279, at 95.

<sup>351</sup> Baruch Fischhoff, *Public Values in Risk Research*, ANNALS AM. ACAD. POL. & SOC. SCI., May 1996, at 75, 78.

<sup>352</sup> For example, in Peru, information about slight cancer risks posed by chlorination without a discussion of the benefits of chlorination led to a ban on chlorinated drinking water. This decision caused a cholera epidemic killing 3500 people. Christopher Anderson, *Cholera Epidemic Traced to Risk Miscalculation*, 354 NATURE 255, 255 (1991).

consequences of weapons? This DUWs case study highlights just how little international law currently says about conditions of uncertainty. The leading approach, a military precautionary principle, is often both indeterminate and insensitive to the harms raised by alternative weapons. Rather than fall prey to heuristics and biases, both the military and environmental advocates should be more attentive to the full range of environmental, health, military, and financial costs presented by weapon use. This Article takes a first step in articulating this approach by suggesting an ongoing duty to evaluate the legality of weapons. Such an amendment to article 36 of Geneva Protocol I could help provide the information needed for a global weapons toxics registry and foster the deployment of cleaner weaponry.