Professor Robert Rhew
Geography 137

William Heegaard
December 14, 2011

Military Security and Environmental Degradation: Challenges and Opportunities

The ecological impact of U.S. military activity has gone underreported for far too long. In this essay I will attempt to explain how the major global environmental problems that we confront today stem from policies that prioritized defense against guns instead of monsoons. Policymakers have defined national security as military dominance over foreign aggressors, ignoring the devastating effects of military operations (and the technologies and industries that support them) on ecosystems at all scales. The environmental degradation caused by the modern military-industrial complex calls into question the unchallenged Truth that aircraft carriers, F-18s and nuclear weapons keep us safe.

Over the past century, the U.S. military has grown to become one of the dominant forces shaping our natural world. Formal wars in Korea, Vietnam, Iraq and Afghanistan, along with discreet operations throughout Latin America, Africa, Asia and the Middle East have expanded U.S. military presence to every corner of the globe. In 2009, the Pentagon managed "a global real property portfolio consisting of more than 539,000 facilities… located on more than 5,570 sites, on approximately 29 million acres,"[1] making it one of the world's biggest landlords.[2] U.S. military expenditures currently account for almost half (43 percent) of the world's total military spending,[3] or more than the next 17 countries combined.[4]

U.S. national security advisors tend to argue that a strong military insures national security and protects citizens from immediate threats to their wellbeing. In response to potential cuts to the Pentagon's budget last year, Secretary of Defense Leon Panetta claimed that the U.S. would become a "paper tiger," leaving American citizens extremely vulnerable to attack by terrorists or rogue states.[5] However, prioritizing military security above all else has had direct and profoundly damaging consequences for the ecosystem services that support human life, both domestically and abroad.

Military decision-makers have purposely destroyed local/regional habitats as a tactic to defeat an adversary. In the U.S. Civil War, Sherman's March wiped out huge swaths of arable land, and during the Vietnam War the U.S. military intentionally used Agent Orange to destroy rainforest cover for guerrilla fighters. In other instances, ecological destruction arose more as a byproduct of conflict. The nuclear fallout after Hiroshima and Nagasaki had a wide range of unanticipated environmental and health effects, while the use of landmines and cluster bombs contaminated agricultural land throughout Asia, Africa, Kosovo, and Afghanistan.[6] In the Gulf War, an estimated 4 to 8 million barrels of oil were spilled into the sea, making it the biggest oil spill in human history.[7] Enough smoke was emitted from burning Kuwaiti oil wells to absorb 75 to 80 percent of the sun's radiation in the region.[8] The full extent of acute environmental destruction

---

[1] "Base Structure Report, Fiscal Year 2009 Baseline." *U.S. Department of Defense, Office of the Deputy Under Secretary of Defense.* http://www.defense.gov/pubs/pdfs/2009baseline.pdf

[2] Chalmers Johnson. "737 U.S. Military Bases = Global Empire." *AlterNet.* February 19, 2007. http://www.alternet.org/story/47998/ As Johnson explains, these figures don't adequate cover all the space the U.S. military occupies globally. Bases in Kosovo, Serbia, Afghanistan, Iraq, Israel, Kyrgyzstan, Qatar, and Uzbekistan have been omitted on the premise that the facilities are provided by other nations. Confidentiality and secrecy also play a role in downplaying the militaries geographic reach.

[3] Sam Perlo-Freeman, et. al. "Military expenditure." *SIPRI Yearbook 2011*. (Oxford University Press: Oxford, 2011). http://www.sipri.org/yearbook/2011

[4] "Always more, or less." *The Economist*. December 1, 2011. http://www.economist.com/blogs/democracyinamerica/2011/12/defence-spending

[5] Ibid.

[6] David Hay-Edie. "The Military's Impact on the Environment: A Neglected Aspect of the Sustainable Development Debate." *International Peace Bureau*. Geneva, August 2002. http://www.ipb.org/i/pdf-files/The_Militarys_Impact_on_the_Environment.pdf

[7] Ibid. Anne Casselman. "10 Biggest Oil Spills in History." *Popular Mechanics*. http://www.popularmechanics.com/science/energy/coal-oil-gas/biggest-oil-spills-in-history#fbIndex1

[8] Peter V. Hobbs and Lawrence F. Radke. "Airborne Studies of the Smoke from the Kuwait Oil Fires." *Science* Vol. 256 (1992): 987-991.

during wartime is unknown, but recent work by journalists and filmmakers clearly documents how "We've become experts in blowing the earth up, huge chunks at a time, using bombs, artillery, motors, C4, gun ships, napalm, using everything but our nuclear arsenal to reduce the earth to ashes."[9]

Little if any of the environmental damage wrought during wartime has ever been cleaned up. As Clay Risen explains, "almost without exception, countries do not pay for these legacies, for a number of reasons: the cost of cleanup is prohibitive; policymakers worry about the impact of paying on national security; and international law cannot hold a polluter accountable."[10] Failure to remove toxic military waste leftover after invasion has only exacerbated the ecological consequences. For instance, in northeastern China, millions of chemical weapons buried by the retreating Japanese army during WWII have created a "slow-motion public health disaster: according to Chinese officials, in the last sixty years more than 2,000 people have died from toxins leaking from the weapons, and countless more have been sickened and permanently injured by them."[11] The high toxicity and long lifespan of discarded military materials means that civilians must suffer the environmental consequences of wars long after they're fought.

Apart from the acute ecological effects of specific wartime strategies and technologies, maintaining a competitive military force is hugely energy and emissions intensive. The U.S. Air Force is the world's single largest consumer of petroleum.[12] As Adam Liska and Richard Perrin assert, "military operations are major industrial activities that use massive amounts of fuel and materials that significantly contribute to climate change."[13] Research done by Nikki Reisch and Steve Kretzmann from Oil Change International concludes that if the war in Iraq was ranked as a country in terms of emissions, it would emit more CO2 each year than 139 (or 60 percent) of the world's nations do annually.[14] The total carbon emissions generated by U.S. military activity in the Middle East has raised the greenhouse gas intensity of gasoline made from imported Middle Eastern oil by 8 to 18 percent.[15] These estimates are conservative, given that emissions associated with the war in Iraq are "literally unreported."[16] Military emissions abroad are exempt from the greenhouse gas inventories that all industrialized nations report under the United Nations Framework Convention on Climate Change.[17] As Reisch and Kretzman write, it's "a loophole big enough to drive a tank through."[18]

America's wars have had severe consequences for ecosystems on all scales, but even in peacetime the Pentagon is still the "largest single source of U.S. environmental pollution," generating "five times more toxins than the five major U.S. chemical companies combined."[19] Specifically, nuclear weapons testing and maintenance has created highly radioactive waste that has decimated once functional ecosystems, and continues to threaten large regions of the U.S. with contamination. At the former plutonium plant in Hanford, Washington (which provided plutonium for the U.S.'s entire Cold-War nuclear arsenal), "240 square miles are uninhabitable due to the radioactivity that has seeped into the soil and ground water… and discharges of more than 216 million liters of radioactive, liquid waste and cooling water have flowed out of leaky tanks."[20] Other sites of nuclear contamination, including Oak Ridge Reservation in Tennessee, Rocky Flats Plant in

---

[9] Interview with James Janko. In *Scarred Lands and Wounded Lives: The Environmental Footprint of War.* Documentary. 2008. http://www.semkhor.com/page.asp?s=scarredlands1&content_id=26432

[10] Clay Risen. "The Environmental Consequences of War." *Washington Monthly* January/February 2010. http://www.washingtonmonthly.com/features/2010/1001.risen.html

[11] Ibid.

[12] Adam Liska and Richard Perrin. "Securing Foreign Oil: A Case for Including Military Operations in the Climate Change Impact of Fuels." *Environment* July-August 2010. http://www.environmentmagazine.org/Archives/Back%20Issues/July-August%202010/securing-foreign-oil-full.html

[13] Ibid.

[14] Nikki Reisch and Steve Kretzmann. "A Climate of War: The war in Iraq and global warming." *Oil Change International*. March 2008.

[15] "Military Greenhouse Gas Emissions: EPA Should Recognize Environmental Impact of Protecting Foreign Oil, Researchers Urge." *Science Daily*. July 21, 2010. http://www.sciencedaily.com/releases/2010/07/100721121657.htm

[16] Nikki Reisch and Steve Kretzmann.

[17] H. Patricia Hynes. "The US Military Assault on Global Climate." *Science for Peace Bulletin*. November 15, 2011. http://www.scienceforpeace.ca/the-us-military-assault-on-global-climate

[18] Nikki Reisch and Steve Kretzmann.

[19] Ibid.

[20] Marc Pitzke. "Hanford Nuclear Waste Still Poses Serious Risks." *Der Spiegel*. March 24, 2011. http://www.spiegel.de/international/world/0,1518,752944,00.html

Colorado, and Yucca Mountain in Nevada, attest to the severe ecological destruction created by military investment in nuclear weapons technology.[21] As Professor Jake Kosek explained in his October 31, 2011 lecture on America's nuclear-industrial complex, the full scale of environmental damage is uncertain, in part because much of the vital information is classified, and in part because the lifetime of nuclear waste is so long (usually tens of thousands of years).[22]

Even if we ignore the catastrophic environmental impact of a nuclear exchange,[23] it is clear that the ecological consequences of waste created from the U.S. military's nuclear weapons program are, and will continue to be, dire. Nuclear power plants have begun to reprocess some of this waste in the form of energy, and the Waste Isolation Pilot Program in New Mexico promises to safely guard the worst of the non-reusable waste for 10,000 years.[24] However, considering the devastation left in the wake of the recent Fukushima nuclear meltdown, along with the potential $700 billion to be spent on revamping U.S. nuclear weapons,[25] it's important to recognize the military's agency in creating and perpetuating such a risk.

While U.S. military investment and activity have directly destabilized ecosystems on a local, regional and global scale, I believe the Pentagon's most damaging legacy has come from its influence in shaping how we perceive national security. Since World War II, scholars and policymakers have criticized the term "national security" for its ambiguity and its inherent power in directing attention and resources to specific problems. As Steve Smith writes, "labeling something as a security issue imbues it with a sense of importance and urgency that legitimizes the use of special measures outside of the usual political process to deal with it."[26] By prioritizing some dangers as national security threats (i.e. North Korea, Al Qaida), the Pentagon has (1) diverted resources from other more arguably pressing problems of public health and ecological sustainability and (2) given itself a free pass to do whatever is necessary (no matter how high the environmental cost) to respond to these threats.

For most of the 20th century, the U.S. military focused exclusively on winning wars, dismissing the environmental consequences as unfortunate byproducts of ensuring national security. The geopolitical realities of World War I, Pearl Harbor, World War II, the Cuban Missile Crisis and the Cold War justified defining national security threats essentially, if not exclusively, in terms of a foreign country's military capacity. To measure a security threat, analysts calculated a country's offensive military capability (how many guns they had and how close they were to U.S. borders), and then made some "rational" judgment about their intentions (the U.K. was less considered threatening than the USSR).[27] With the advent of nuclear weapons, policymakers actively institutionalized this definition under the logic of deterrence. As Michael Clarke explains, the Cold War and the operative policy of nuclear deterrence defined "what was seen as important, what was ignored, what motives to conflict were assumed to exist, what constituted significant conflict, and even more what constituted a risk of conflict."[28] The military safeguarded U.S. national security by staying one nuclear warhead ahead of the Soviet Union.

The changing nature of military conflict after the Cold War forced security scholars and policymakers to rethink what was actually a threat to national security, and whether traditional definitions were even applicable. Ethnic and intrastate violence grew to replace organized interstate warfare as the dominant pattern of global violence. By the 90s, ten of the 118 documented armed conflicts in the world could be strictly classified as interstate conflicts.[29] As Gearóid Tuathail writes, "Pentagon planners began to

---

[21] J. Leaning. "Environment and health: 5. Impact of war." *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* 163 (9) (October 31, 2000): 1157-61.
[22] Jake Kosek. Lecture. October 31, 2011.
[23] Alan Robock. "Nuclear winter is a real and present danger." *Nature* 473 (7347) (May 19, 2011): 275-6.
[24] For more information on the Waste Isolation Pilot Program (WIPP), see http://www.wipp.energy.gov/
[25] See Glenn Kessler. "Will the United States really spend $700 billion in the next decade on nuclear weapons programs." *The Washington Post*. November 30, 2011. http://www.washingtonpost.com/blogs/fact-checker/post/will-the-united-states-really-spend-700-billion-in-the-next-decade-on-nuclear-weapons-programs/2011/11/29/gIQAbEAtBO_blog.html
[26] Steve Smith. "The Increasing Insecurity of Security Studies: Conceptualizing Security in the Last Twenty Years." In *Critical Reflections on Security and Change*, edited by Stuart Croft and Terry Terriff. (Frank Cass: London, 2000). Pg. 85.
[27] Myriam Dunn Cavelty. "From Threats to Risks in International Security – and Subsequent Challenges for 'Knowing' the Future." *International Relations and Security Network*. November 16, 2011. http://www.isn.ethz.ch/isn/Current-Affairs/Special-
[28] Michael Clarke. "Introduction." In *New Perspectives on Security*, edited by Michael Clarke. (Brassey's: London, 1993). Pg. 2.
[29] Dan Smith. "Trends and Causes of Armed Conflict." *Berghof Research Center for Constructive Conflict Management*. August

conceptualize and operationalize how they should be dealing with informal warfare, failed states, proliferating toxic substances and peacekeeping operations in environmentally stressed region," worrying about both "hard" threats (transnational terrorist networks and the proliferation of weapons of mass destruction), and "soft" threats posed by "global environmental problems (access to scarce resources, population pressures and environmental stress), international migration and violent ethnic nationalism."[30]

If the fall of the Berlin Wall helped broaden the scope of national security to include problems of sustainability and public health, the fall of the Twin Towers reprioritized military force as the almost exclusive guarantor of national security. The United State's biggest threat was no longer a foreign country, but a dispersed group of radical individuals that wanted to watch America burn. To ensure the safety and wellbeing of U.S. citizens, the Pentagon needed to find and eliminate these individuals by whatever means necessary. Discussions of less tangible, more systemic security problems (like climate change) were pushed to the side.

In a 2010 article published in *Foreign Policy*, John Mueller and Mark Stewart evaluate the U.S. government's investment in counterterrorism (specifically the Department of Homeland Security's budget) by comparing it to other managed risks. As they explain, "Over the last several decades, academics, policymakers, and regulators worldwide have developed risk-assessment techniques to evaluate hazards to human life, such as pesticide use, pollution, and nuclear power plants."[31] Policy guidelines for these other strategies point to a rough international standard of acceptable, tolerable, and unacceptable risks: "risks are deemed unacceptable if the annual fatality risk is higher than 1 in 10,000 or perhaps higher than 1 in 100,000 and acceptable if the figure is lower than 1 in 1 million or 1 in 2 million."[32] Applying this rubric to terrorism, it's clear that for the United States, terrorist attacks represent a clearly acceptable risk, one that doesn't merit any increase in investment to manage. Then why does military funding to combat terrorism receive so much support, especially when there are clearly more dangerous health and environmental problems to take care of?

Although technical risk assessments wield substantial influence in framing national security priorities, civil and political pressure also plays a major role in directing military policy. After all, wasn't the American public clamoring for retribution after September 11th? In his book *Why We Disagree about Climate Change*, Mike Hulme spends a chapter discussing why "rational" evaluations of risk don't end up explaining policy decisions. As he explains:

> Risk assessment, or risk quantification is not the sole preserve of the expert or the scientist. Such analysts may have specific knowledge and technical skills that the majority of citizens do not have, and they may be able to evaluate different types of risk, but in the end it is the individuals who have the last word in any risk assessment.[33]

Non-experts assess risks not with numbers and graphs, but with symbols and feelings. The image of Twin Towers, two pillars of U.S. nationalism, falling to a select group of foreign conspirators incites much more public fear and anger than the image of the West Antarctic Ice Sheet melting. Damage caused by a terrorist attack also offers a clear culprit, and therefore a clear solution. In response to 9/11, it was easy to claim that all we had to do was kill the terrorists to be safe. In comparison, environmental problems like climate change require coordinated international efforts, non-military action and acknowledgement of our own responsibility in creating them. Under this light, it's easier to understand why civilians tackle terrorism instead of addressing the longer-term security risks that stem from environmental degradation.

If non-experts' irrational risk assessments are the dominant force behind government prioritization of acceptable risks like terrorism above unacceptable risks like cancer or natural disasters, then the Pentagon now might actually represent more of a solution than a problem. Although military activity and maintenance

---

2004. http://www.berghof-handbook.net/all/

[30] Gearóid Tuathail. "De-territorialized Threats and Global Dangers: Geopolitics, Risk Society and Reflexive Modernization." *Geopolitics* 3 (1) (1998): 17-31.

[31] John Mueller and Mark G. Stewart. "Hardly Existential: Thinking Rationally About Terrorism." *Foreign Affairs*. April 2, 2010. http://www.foreignaffairs.com/articles/66186/john-mueller-and-mark-g-stewart/hardly-existential

[32] Ibid.

[33] Mike Hulme. *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity*. (Cambridge University Press: Cambridge, 2009). Pg. 184.

causes direct and profound damage to ecosystems (as I've shown), the Pentagon has recognized the national security threat posed by climate change and environmental degradation, and has begun to call for serious investment in mitigation and alternative energy to prevent "threat multiplication."[34] The military's extremely high petroleum bill,[35] combined with estimates of oil shortages by 2015,[36] has also pushed the Pentagon to quietly lead the quest for renewable energy.[37] The Air Force is now the largest renewable energy power purchaser in the U.S., and third largest in the world.[38] However, put in perspective, the U.S. military still has a long way to go:

> "In 2006, the U.S. spent more on the war in Iraq than the entire world spent on renewable energy investment…The projected full costs of the Iraq War (estimated $3 trillion) would cover "*all of the global investments* in renewable power generation" needed between now and 2030 to reverse global warming trends."[39]

In conclusion, the U.S. military arguably represents the greatest global environmental challenge the world has ever faced. U.S. military operations have intentionally decimated local and regional ecosystems to win wars. Even if the destruction didn't come from a formal order, U.S. military involvement in conflicts around the world (whether successful or not) has fueled environmental degradation on global scale. U.S. arms sales make up 39 percent of the total arms trade: we are the world's armory.[40] We also consider ourselves to be the world's police force, and managing global violence is an industrial process that requires massive amounts of energy and generates significant carbon emissions.

Military investment in the name of national security has also created nuclear weapons. Not only would any nuclear exchange inflict catastrophic environmental damage, but the radioactive waste generated from arms production contaminates large ecosystem services fundamental to human survival (i.e. groundwater tables) for thousands of years.

Finally, defining national security as foreign people with guns has stalled research and response to other, clearly more pressing environmental and health risks. While recent statements and reports from the Pentagon suggest a change in security priorities, the military's sustained operations in the Middle East reflect traditional military logic that ignores environmental concerns. Although military investment in renewable energy technologies may pave the road to an energy revolution, it's clear that for now, serious changes must be made to mitigate the Pentagon's acute and systemic degradation of the natural systems that support life on earth.

---

[34] See *National Security and the Threat of Climate Change*. The CNA Corporation's Miliatary Advisory Board. 2007. http://www.cna.org/reports/climate; John M. Broder. "Climate Change Seen as Threat to U.S. Security. *The New York Times*. August 8, 2009. http://www.nytimes.com/2009/08/09/science/earth/09climate.html?pagewanted=1

[35] Steve Geisi. "Pentagon is investing in a greener military." *The Wall Street Journal*. August 24, 2011. http://www.marketwatch.com/story/pentagon-is-investing-in-a-greener-military-2011-08-24

[36] Terry Macalister. "US military warns oil output may dip causing massive shortages by 2015." *The Guardian*. April 11, 2010. http://www.guardian.co.uk/business/2010/apr/11/peak-oil-production-supply

[37] Sohbet Karbuz. "US military energy consumption- facts and figures." Energy Bulletin. *Post Carbon Institute.* May 20, 2007. http://www.energybulletin.net/node/29925

[38] Ibid.

[39] H. Patricia Hynes.

[40] Richard F. Grimmett, "Conventional Arms Transfers to Developing Nations, 2003-2010." *CRS Report for Congress*. September 22, 2011. http://www.fas.org/sgp/crs/weapons/R42017.pdf

Appendix

Table 4A.1. The 15 countries with the highest military expenditure in 2010

Spending figures are in US$, at current prices and exchange rates. Countries are ranked according to military spending calculated using market exchange rates (MER). Figures for military spending calculated using purchasing power parity (PPP) exchange rates are also given.

Rank	Country	Spending ($ b., MER)	Change, 2001–10 (%)	Share of GDP (%, estimate)[a]	World share (%)	Spending ($ b., PPP)[b]
1	United States	698	*81.3*	*4.8*	*43*	698
2	China	[119]	*189*	*[2.1]*	*[7.3]*	[210]
3	United Kingdom	59.6	*21.9*	*2.7*	*3.7*	57.6
4	France	59.3	*3.3*	*2.3*	*3.6*	49.8
5	Russia	[58.7]	*82.4*	*[4.0]*	*[3.6]*	[88.2]
Sub-total top 5		**995**			*61*	
6	Japan	54.5	*–1.7*	*1.0*	*3.3*	43.6
7	Saudi Arabia[c]	45.2	*63.0*	*10.4*	*2.8*	64.6
8	Germany	[45.2]	*–2.7*	*[1.3]*	*[2.8]*	[40.0]
9	India	41.3	*54.3*	*2.7*	*2.5*	116
10	Italy	[37.0]	*–5.8*	*[1.8]*	*[2.3]*	[32.2]
Sub-total top 10		**1 218**			***75***	
11	Brazil	33.5	*29.6*	*1.6*	*2.1*	36.2
12	South Korea	27.6	*45.2*	*2.8*	*1.7*	40.8
13	Australia	24.0	*48.9*	*2.0*	*1.5*	17.3
14	Canada	[22.8]	*51.8*	*[1.5]*	*[1.4]*	[19.4]
15	Turkey	[17.5]	*–12.2*	*[2.4]*	*[1.1]*	[23.9]
Sub-total top 15		**1 344**			*82*	
World		**1 630**	***50.3***	***2.6***	***100***	

[ ] = estimated figure; GDP = gross domestic product.

[a] The figures for national military expenditure as a share of GDP are based on estimates for 2010 GDP from the IMF *World Economic Outlook*, October 2010.

[b] The figures for military expenditure at PPP exchange rates are estimates based on the ratio of PPP to MER-based GDP projections for 2010 implicit in the International Monetary Fund's *World Economic Outlook*. Thus, military expenditure figures at MER rates have been multiplied by the same ratio to obtain the PPP estimates.

[c] The figures for Saudi Arabia include expenditure on public order and safety and might be slight overestimates.

Sources: SIPRI Military Expenditure Database, <http://www.sipri.org/databases/milex/>; and International Monetary Fund, *World Economic Outlook* database, Oct. 2010, <http://www.imf.org/external/pubs/ft/weo/2010/02/weodata/index.aspx>.

Figure 1. Sam Perlo-Freeman, et. al. "Military expenditure." *SIPRI Yearbook 2011*. (Oxford University Press: Oxford, 2011). http://www.sipri.org/yearbook/2011

Comparison of Annual Fatality Risks

Hazard	Territory	Period	Total fatalities for the period	Annual fatality risk
World War II	World	1939–45	61,000,000	1 in 221
Cancers	United States	2009	560,000	1 in 540
War (civilians)	Iraq	2003–8	113,616	1 in 1,150
All accidents	United States	2007	119,000	1 in 2,500
Traffic accidents	United States	2008	34,017	1 in 8,000
Traffic accidents	Canada	2008	2,431	1 in 13,500
Traffic accidents	Australia	2008	1,466	1 in 15,000
Homicide	United States	2006	14,180	1 in 22,000
Traffic accidents	United Kingdom	2008	2,538	1 in 23,000
Terrorism	**Northern Ireland**	**1970–2007**	**1,758**	**1 in 43,000**
Industrial accidents	United States	2007	5,657	1 in 53,000
Homicide	Canada	2008	611	1 in 55,000
Intifada	**Israel**	**2000–6**	**553**	**1 in 72,000**
Homicide	Great Britain	2008	887	1 in 67,000
Homicide	Australia	2008	290	1 in 76,000
Terrorism	**United States**	**2001**	**2,982**	**1 in 101,000**
Natural disasters	United States	1999–2008	6,294	1 in 480,000
Drowning in bathtub	United States	2003	320	1 in 950,000
Terrorism	**United Kingdom**	**1970–2007**	**2,196**	**1 in 1,100,000**
Home appliances	United States	Yearly average	200	1 in 1,500,000
Deer accidents	United States	2006	150	1 in 2,000,000
Commercial aviation	United States	1989–2007	1,955	1 in 2,900,000
Terrorism	**United States**	**1970–2007**	**3,292**	**1 in 3,500,000**
Terrorism	**Canada**	**1970-2007**	**336**	**1 in 3,800,000**
Terrorism	**Great Britain**	**1970–2007**	**434**	**1 in 5,200,000**
Lightning	United States	1999–2008	424	1 in 7,000,000
Transnational terrorism	**World outside war zones**	**1975–2003**	**13,971**	**1 in 12,500,000**

Figure 2. John Mueller and Mark G. Stewart. "Hardly Existential: Thinking Rationally About Terrorism." *Foreign Affairs*. April 2, 2010. http://www.foreignaffairs.com/articles/66186/john-mueller-and-mark-g-stewart/hardly-existential

Bibliography

"Always more, or less." *The Economist*. December 1, 2011. http://www.economist.com/blogs/democracyinamerica/2011/12/defence-spending

"Base Structure Report, Fiscal Year 2009 Baseline." *U.S. Department of Defense, Office of the Deputy Under Secretary of Defense.* http://www.defense.gov/pubs/pdfs/2009baseline.pdf

Broder, John M. "Climate Change Seen as Threat to U.S. Security. *The New York Times*. August 8, 2009. http://www.nytimes.com/2009/08/09/science/earth/09climate.html?pagewanted=1

Cavelty, Myriam Dunn. "From Threats to Risks in International Security – and Subsequent Challenges for 'Knowing' the Future." *International Relations and Security Network*. November 16, 2011. http://www.isn.ethz.ch/isn/Current-Affairs/Special-

Clarke, Michael. "Introduction." In *New Perspectives on Security*, edited by Michael Clarke. (Brassey's: London, 1993).

Geisi. Steve. "Pentagon is investing in a greener military." *The Wall Street Journal*. August 24, 2011. http://www.marketwatch.com/story/pentagon-is-investing-in-a-greener-military-2011-08-24

Grimmett, Richard F. "Conventional Arms Transfers to Developing Nations, 2003-2010." *CRS Report for Congress*. September 22, 2011. http://www.fas.org/sgp/crs/weapons/R42017.pdf

Hay-Edie, David. "The Military's Impact on the Environment: A Neglected Aspect of the Sustainable Development Debate." *International Peace Bureau*. Geneva, August 2002. http://www.ipb.org/i/pdf-files/The_Militarys_Impact_on_the_Environment.pdf

Hobbs, Peter V. and Radke, Lawrence F. "Airborne Studies of the Smoke from the Kuwait Oil Fires." *Science* Vol. 256 (1992): 987-991.

Hulme, Mike. *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity*. (Cambridge University Press: Cambridge, 2009).

Hynes, H. Patricia. "The US Military Assault on Global Climate." *Science for Peace Bulletin*. November 15, 2011. http://www.scienceforpeace.ca/the-us-military-assault-on-global-climate

Janko, James. Interview. In *Scarred Lands and Wounded Lives: The Environmental Footprint of War.* Documentary. 2008. http://www.semkhor.com/page.asp?s=scarredlands1&content_id=26432

Johnson, Chalmers. "737 U.S. Military Bases = Global Empire." *AlterNet.* February 19, 2007. http://www.alternet.org/story/47998/

Karbuz, Sohbet. "US military energy consumption- facts and figures." Energy Bulletin. *Post Carbon Institute.* May 20, 2007. http://www.energybulletin.net/node/29925

Kessler, Glenn. "Will the United States really spend $700 billion in the next decade on nuclear weapons programs?" *The Washington Post*. November 30, 2011. http://www.washingtonpost.com/blogs/fact-checker/post/will-the-united-states-really-spend-700-billion-in-the-next-decade-on-nuclear-weapons-programs/2011/11/29/gIQAbEAtBO_blog.html

Kosek, Jake. Lecture. UC Berkeley, October 31, 2011, in Geography 137, taught by Robert Rhew.

Leaning, J. "Environment and health: 5. Impact of war." *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* 163 (9) (October 31, 2000): 1157-61.

Liska, Adam and Perrin, Richard. "Securing Foreign Oil: A Case for Including Military Operations in the Climate Change Impact of Fuels." *Environment* July-August 2010. http://www.environmentmagazine.org/Archives/Back%20Issues/July-August%202010/securing-foreign-oil-full.html

Macalister, Terry. "US military warns oil output may dip causing massive shortages by 2015." *The Guardian*. April 11, 2010. http://www.guardian.co.uk/business/2010/apr/11/peak-oil-production-supply

"Military Greenhouse Gas Emissions: EPA Should Recognize Environmental Impact of Protecting Foreign Oil, Researchers Urge." *Science Daily*. July 21, 2010. http://www.sciencedaily.com/releases/2010/07/100721121657.htm

Mueller, John and Stewart, Mark G. "Hardly Existential: Thinking Rationally About Terrorism." *Foreign Affairs*. April 2, 2010. http://www.foreignaffairs.com/articles/66186/john-mueller-and-mark-g-stewart/hardly-existential

National Security and the Threat of Climate Change. The CNA Corporation's Miliatary Advisory Board. 2007. http://www.cna.org/reports/climate

Perlo-Freeman, Sam et. al. "Military expenditure." *SIPRI Yearbook 2011*. (Oxford University Press: Oxford, 2011). http://www.sipri.org/yearbook/2011

Pitzke, Marc. "Hanford Nuclear Waste Still Poses Serious Risks." *Der Spiegel*. March 24, 2011. http://www.spiegel.de/international/world/0,1518,752944,00.html

Reisch, Nikki and Kretzmann, Steve. "A Climate of War: The war in Iraq and global warming." *Oil Change International*. March 2008.

Risen, Clay. "The Environmental Consequences of War." *Washington Monthly* January/February 2010. http://www.washingtonmonthly.com/features/2010/1001.risen.html

Robock, Alan. "Nuclear winter is a real and present danger." *Nature* 473 (7347) (May 19, 2011): 275-6.

Smith, Dan. "Trends and Causes of Armed Conflict." *Berghof Research Center for Constructive Conflict Management*. August 2004. http://www.berghof-handbook.net/all/

Smith, Steve. "The Increasing Insecurity of Security Studies: Conceptualizing Security in the Last Twenty Years." In *Critical Reflections on Security and Change*, edited by Stuart Croft and Terry Terriff. (Frank Cass: London, 2000).

Tuathail, Gearóid. "De-territorialized Threats and Global Dangers: Geopolitics, Risk Society and Reflexive Modernization." *Geopolitics* 3 (1) (1998): 17-31.