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A New Vigilance: Identifying and Reducing the Risks of Environmental Terrorism

Elizabeth L. Chalecki*

Environmental terrorism is an old type of conflict with a new face. Large, costly wars between two or more states have become less prevalent over the past 50 years, and with the end of the Cold War and the demise of the Soviet Union, there has been no bipolar superpower standoff to suppress the many ethnic, religious, and multipolar political and cultural tensions that motivate terrorist actions. Even the very nature of terrorism itself is changing. Attacks are becoming lethal to a greater number of people, as the events of September 11, 2001 demonstrated to the world. Most recent discussions of terrorism have focused on the identity of the terrorists, their motivations, and the increasingly destructive potential of the "weapons" at their disposal. However, to date, there has been relatively little discussion about their choice of targets. Environmental security scholars know that a strong argument can be made for linking certain resource and environmental problems with the prospects for political tension, or even war and peace. History shows that access to resources has been a proximate cause of war, resources have been both tools and targets of war, and environmental degradation and disparity in the distribution of resources can cause major political controversy, tension, and violence.¹

Terrorism experts have opined that, in the last decade, the nature of terrorism has changed from professional, politically-motivated acts to amateur acts motivated by any number of grievances: religious, social, political, or personal.² There are well-known ambiguities in defining "terrorism" and specifically "environmental terrorism." Yet there are also real risks facing governments and the public and an effort must be made to better understand these risks and appropriate responses. An examination of environmental terrorism adds a new dimension to these definitions, identifying the target as a natural resource or envi-

* My thanks to Gary Wolff for discussions on the possible costs of environmental terrorism, and to the Ploughshares Fund for its support.

1. See Gleick 1993 and 1998; Lee 1995; Wolf 1998; Lietzmann and Vest 1999; and Baechler 1999, among others.
2. Gilmore Commission 1999; Hoffman 1999; Chalk 2000; Laqueur 1996 and 1999; and Wilkinson 1996.

ronmental feature. At a time when populations all over the world are increasing, the existing resource base is being stretched to provide for more people, and is being consumed at a faster rate. As the value and vulnerability of these resources increase, so does their attractiveness as terrorist targets. The destruction of a natural resource can now cause more deaths, property damage, political chaos, and other adverse effects than would have been the case in any previous decade.

This paper will define environmental terrorism as distinct from eco-terrorism and from environmental warfare, discuss the risk of environmental terrorism as a function of consequence and probability, and examine various types of attacks that use the environment both as a target and a tool of terror. Finally, several ideas for reducing the risk of environmental terrorism will be discussed.

Defining Environmental Terrorism

There are as many definitions of terrorism as there are acts of terrorism. Like pornography, it seems to depend on the perceptions and politics of the viewer. Terrorism as a concept first appeared in the Oxford English Dictionary in 1795 as, "a government policy intended to strike with terror those against whom it is adopted." Over the course of the next two centuries, terrorism went from being defined as government-sponsored policy to being regarded as anti-government policy. The word "terrorism" began to have an exclusively negative connotation by the middle of the 20th century, so that terrorist groups wishing to avoid bad publicity began calling themselves "freedom fighters," and governments employing terrorist tactics against opponents began calling them "police actions." Today, the word "terrorism" brings to mind hijacked airliners, the World Trade Center, and the violent death of unsuspecting people.

The FBI definition of terrorism states that terrorism is "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." Title 22, Section 2656 of the US Code states that terrorism "means premeditated, politically motivated violence perpetrated against non-combatant targets by subnational groups or clandestine agents, usually intended to influence an audience." Both of these definitions concern themselves primarily with the motive behind terrorist actions and not with the selection of target, other than defining it as "non-combatant persons or property."

Regardless of the actual definition employed, acts of terrorism have four essential components: motivation, means, target, and enemy. For example, Osama bin Laden's motivation in the New York and Washington attacks was political and religious, his means were four jet airliners, and his targets were the World Trade Center and the Pentagon. But he chose those targets because they represented his enemy, the United States. Terrorists, whether groups or individuals, have various motivations: religious, cultural, political, economic, psychological, or some combination of these. The means at their disposal are often explosives, guns, poisons, or other destructive agents, although, as the recent at-

tacks showed, they can employ more creative weapons. Their enemies are usually governments or political figures, but with the advent of eco-terrorism, we see enemies such as commercial developers and biotechnology firms. And their targets are often chosen because of what they represent for the terrorists.³ These targets may be skyscrapers, federal buildings, and—rivaling both of those for the amount of long-term damage that can be inflicted upon a country—*environmental resources*. For the purposes of this paper, environmental terrorism can be defined as the unlawful use of force against *in situ* environmental resources so as to deprive populations of their benefit(s) and/or destroy other property.

Environmental Terrorism vs. Eco-Terrorism

Most readers, when they hear the term “environmental terrorism” are actually thinking of eco-terrorism. Not to be confused with environmental terrorism, eco-terrorism is the violent destruction of property perpetrated by the radical fringes of environmental groups in the name of saving the environment from further human encroachment and destruction.⁴ Based in deep ecology theory, the professed aim of eco-terrorists is to slow or halt exploitation of natural resources and to bring public attention to environmental issues such as unsustainable logging or wildlife habitat loss through development.

Earth First! is the organization that first brought eco-terrorism to the public debate. Founded in 1980, Earth First! is known for tree-spiking in the Pacific Northwest (although they have since repudiated this tactic),⁵ and protests against activities such as old-growth logging, road building in wilderness areas, and dam construction. Its furor wound down under pressure from law enforcement groups. In addition, when the environmentally friendly Clinton Administration took office, the group believed that its agenda would receive positive attention.⁶ The modern inheritor of the eco-terrorist mantle is the Environment Liberation Front (ELF), an Earth First! splinter group formed in 1993 in England. In an action purportedly aimed at saving lynx habitat, the American wing of ELF burned down a ski lodge in Vail, Colorado in October 1998, resulting in \$12 million in property damage, an act ironically repudiated by Earth First! itself.⁷ ELF made headlines in January 2001, when members set fire to newly built homes on Long Island to protest what they view as humans’ unceasing encroachment on nature, and again in March 2001, when they set fire to a warehouse containing transgenic cotton seed⁸ and a biogenetic research facility at the University of Washington.⁹ Because the group is decentralized and ideologi-

3. Drake 1998, 53.

4. *San Francisco Chronicle*, 1 July 2001, A10.

5. See Judi Bari, “The Secret History of Tree-Spiking,” *EarthFirst! Journal*, 21 December 1994, as found at bari.iww.org/iul20/local/judi11.html.

6. Zakin 1993, 442.

7. FACTNet, Inc., October 1998, as found at www.factnet.org/cults/earth_liberation_front/vail_fire.html; and *Associated Press*, 23 October 1998.

8. *San Francisco Chronicle*, 6 March 2001, A2.

9. *New York Times*, 23 May 2001.

cally motivated, and thus extremely difficult to catch, the FBI considers ELF its number one domestic terrorist threat.¹⁰

At first glance, the distinction between environmental terrorism and eco-terrorism might seem academic. However, operationally there is a significant difference. Environmental terrorism involves targeting natural resources. Eco-terrorism involves targeting built environment such as roads, buildings and trucks, ostensibly in defense of natural resources. Earth First!, ELF, and other eco-terrorists do not practice environmental terrorism *per se* if they do not choose environmental resources as their targets. ELF has targeted a ski resort, houses on Long Island, logging trucks and office buildings, but has damaged no resources and killed no one. (In fact, ELF claims to go out of its way to avoid human casualties.¹¹) It could be argued that ELF did commit environmental terrorism by burning the transgenic cotton seed. However, the members would likely argue that genetically engineered plants are not “natural” and hence are not an environmental resource. Their stated aim remains to inflict economic damage to built facilities in defense of the environment, an important distinction to be made when considering the intersection of environmental issues and terrorism.

Environmental Terrorism vs. Environmental Warfare

The difference between environmental terrorism and more conventional environmental warfare is one that mirrors the larger difference between terrorism and warfare in general. The easy distinction, that warfare is conducted by states and terrorism by rebel groups, obscures the uncomfortable fact that unlawful acts against non-combatants are often carried out by states. Warfare is governed by two complementary criteria: *jus ad bellum* (war must be declared for a good reason) and *jus in bello* (war must be conducted in a just fashion). The first criterion states that the cause for war must be right and that legal, economic, diplomatic, and all other recourses must have been attempted. However, the government of a state fighting a civil war might “rightly” see rebel forces as threats to the existence of the state, whereas the same rebel forces might “rightly” see the government as an oppressing force. Because there is no universally accepted judgment as to what constitutes rightness of cause, applying this criterion to terrorism is problematic.

The second criterion contains several behavioral constraints on the part of the combatants, chief among them the principle of discrimination: non-combatants are not to be targeted in the conflict.¹² Terrorism clearly violates the *jus in bello* criterion, since targeting non-combatants lies at the very core of its strategy. That the target is environmental and not human does not blur the distinction between warfare and terrorism. Environmental warfare operates within the larger objective of war: to defeat the enemy’s military forces or capacity. The

10. *Washington Post*, 13 January 2001, C13.

11. *New York Times*, 8 January 2001.

12. For a more comprehensive summary, see Beres 1995; or Stern 1999.

jus in bello criterion, the guiding force behind the Geneva Conventions and the Environmental Modification Convention, indicates that while collateral environmental damage may occur, environmental resources are not to be intentionally targeted during war unless there is a direct military advantage to doing so. The objective of environmental terrorism, however, is to have a psychological effect on the target population, and just as terrorists do not apply the *jus in bello* criterion to human non-combatants, neither do they apply it to the environment.

Risk of Environmental Terrorism: Consequence vs. Probability

The United States is a signatory to eleven major multilateral conventions related to states' responsibilities for combating terrorism. Currently, almost every federal agency has some responsibility for terrorism planning and response. The State Department, the Environmental Protection Agency, the Department of Defense, the Federal Emergency Management Agency, the Justice Department, the FBI, and others are all spending millions of dollars to prepare for and respond to acts of terrorism. For the FBI alone, counter-terrorism spending and manpower have gone from \$78.5 million and 550 agents in 1993 to \$301.2 million and 1,393 agents in 1999.¹³ In fiscal year 2001, \$1.555 billion have been requested to protect against chemical, biological, radiological and nuclear attacks.¹⁴ In September of 2001, the US Congress authorized a \$20 billion emergency fund to assist the victims of the September 11 attack and punish the perpetrators.¹⁵

Environmental terrorism, however, can be more efficacious than either a standard conventional weapon attack on civil targets or "weapons of mass destruction" (WMD) attack involving chemical, biological, radiogenic, or nuclear weapons, the "worst-case" scenarios. This is because its risk profile is different. There are two components to measuring the risk of terrorism: severity of the attack, and the probability of a particular scenario actually occurring. This is where the approximately \$7 billion¹⁶ spent to analyze WMD attacks may be misspent: scenarios such as detonation of a nuclear device or deployment of a biological weapon in a populated area, while frightening, fall into the high-consequence/low-probability category. As risky are the common, low-consequence/high-probability scenarios such as bombings or kidnapping (low-consequence only in that the number of people directly affected is relatively small compared to a large-scale WMD incident). Environmental terrorism has the potential to combine the worst of both of these scenarios: it can have higher consequences than conventional civil terrorism because the potential damage from an environmental attack can be long-lasting and widespread, and it is

13. Freeh 1999.

14. Chalk 2001.

15. *Washington Post*, 13 September 2001, A3.

16. *Weekly Defense Monitor*, 1 October 1998, 2.

more likely than WMD terrorism because it can be carried out using conventional explosives or poisons.

WMDs are still extremely difficult to obtain and deploy successfully, and are consequently out of range for most amateur terrorist individuals or groups.¹⁷ As a result, terrorists may increase their destructive potential by directing conventional methods against environmental targets, where they are likely to cause more human health and economic damage with less risk to themselves. Federal counter-terrorism spending priority ought to consider what is practical and likely, not just what is flashy or media-induced.¹⁸ This is not a suggestion that federal agencies no longer consider the risks and consequences of WMD terrorism, but rather that additional attention be paid to environmental terrorism.

Environmental Terrorism and Popular Media

RAND terrorism expert Brian Jenkins has cautioned that assessment of possible terrorist threats of any kind is heavily influenced by popular culture. Entertainment often portrays terrorist threats for suspense value, and environmental terrorism has begun to rank among those threats. Various novels and movies such as *The Monkey Wrench Gang*,¹⁹ *H.M.S. Unseen*²⁰ and Steven Seagal's *On Deadly Ground* have featured acts of environmental terrorism such as blowing up dams and oil platforms for political or environmental purposes. According to Jenkins, policy-makers read these books or see these movies and become convinced that such a situation might actually occur. They then spend time and resources analyzing these "threats" and this very process legitimizes a scenario that otherwise might never have occurred.²¹ It seems that while this caveat may be founded in reality, Jenkins' advice is unclear: do we withdraw terrorist scenarios from popular entertainment? Do we keep serious analysis of these threats secret from public knowledge? Do we assume that if a particular scenario appears in a movie, it's too outlandish to actually happen? We know this is not true: the pilot episode of the "X-Files" spin-off show "The Lone Gunmen" features a hijacked airliner being flown from Boston into the World Trade Center! If popular writers, and even the author of this paper, can think up scenarios such as these, it seems safe to assume that more motivated individuals such as terrorists can do so as well.

Another media angle arises when we consider the relationship of terrorists and journalists. Terrorism scholar Walter Laqueur points out that the media's preoccupation with some countries and not others and with cities over countryside leads terrorist groups to change their tactics so as to garner maximum media exposure.²² Certainly the 24-hour media coverage following the New York

17. *New York Times*, 26 October 2000, A20; and *Weekly Defense Monitor*, 1 October 1998, 2.

18. *RAND Review*, Fall 2000, 5.

19. Abbey 1975.

20. Robinson 1999.

21. *RAND Review*, Fall 2000, 5.

22. Laqueur 1999, 44-45.

and Washington incidents was every terrorist's dream, and environmental terrorists may have to follow this example. As environmental awareness increases in both the media and the general public, environmental targets begin to look more and more attractive as their importance to society becomes clearer.

Resource-as-Tool Terrorism and Resource-as-Target Terrorism

There are various ways to define environmental terrorism further,²³ but this report will consider two types: resource-as-tool terrorism and resource-as-target terrorism. The former occurs when environmental resources such as crops, livestock, or water supplies are used as delivery vehicles to carry a destructive agent to a human population. For example, terrorists wishing to inflict damage using resource-as-tool terrorism on a town below a reservoir might poison the water supply. Conversely, the latter occurs when the environment or resources themselves are targeted for destruction or compromise, with the collateral damages being felt by the population the terrorists wish to impact. Using the same example, terrorists wishing to employ resource-as-target terrorism might blow up the dam and flood the town. While these types of attacks are atypical now, according to terrorism experts,²⁴ they appear to be becoming more prevalent as terrorists adopt more single-issue agendas, and as WMD technology remains difficult to obtain and deploy. Moreover, there is a long history of the use of resources as both targets and tools during war.²⁵ Following are numerous examples of both types of environmental terrorism; the applicable type depends upon the particular environmental resource being targeted.

Vulnerable Resources

Criteria to assess the likelihood of an environmental attack can be developed by attempting to identify the attributes of a resource or a particular site that render it vulnerable to some form of environmental terrorism. Physical attributes such as scarcity and prestige of the targeted resource, its physical location, its vulnerability to attack and capacity for regeneration are the key determinants. Resources that are relatively inaccessible or heavily guarded are less attractive to terrorists, since attacking such a target presents less chance of successful escape. Geopolitical considerations also play a role: international terrorists striking at another country might choose a resource close to the border rather than one deep inside national borders. Scarcity of the resource is important, since greater economic and even physical hardship can be inflicted by attacking a resource such as fresh water, for which there is no substitute. Redundancy of the resource

23. Schwartz 1998.

24. Chalk 2000.

25. For examples related to water resources, see the Pacific Institute's water conflict chronology developed by Gleick (1998), also available on-line at www.worldwater.org/conflictIntro.htm. This chronology includes details of acts of environmental terrorism.

is also a consideration: a country with few freshwater sources is likely to be more vulnerable than one with multiple sources.

Other non-physical attributes such as economic, political, and cultural factors also bear on terrorist selection of vulnerable resources. Greater economic value, often linked to physical scarcity, makes a resource very attractive. Resources with high cultural or social value can also become targets: giant panda bears, California redwood trees, koalas, bald eagles, and the Nile River are all cultural icons for their respective countries, and have significance far greater than their economic value. One example is the recent intentional attack on an environmental icon—Luna, the old-growth redwood tree occupied by environmental activist Julia “Butterfly” Hill.

Water Resource Sites

Sites involving water resources are vulnerable to environmental terrorist attacks in the form of explosives or the introduction of poison or disease-causing agents. The damage is done by rendering the water unusable and/or destroying the purification and supply infrastructure. Water resource sites have many vulnerable physical attributes that make them attractive to terrorists. Most water infrastructure, such as dams, reservoirs, and pipelines are easily accessible to the public at various points. Many dams such as Hoover or Glen Canyon are tourist attractions and offer tours to the public, while many reservoirs such as the Triadelphia outside Washington, DC are open to the public for recreational boating and swimming. A terrorist carrying a small but powerful explosive device would not necessarily be conspicuous among tourists, sport fishermen, or hikers.

Water resource sites are also attractive to environmental terrorists because water is a vitally necessary resource for which there is no substitute. Whether its lack is due to a physical supply interruption or not, a community of any size that lacks fresh water will suffer greatly. Furthermore, a community does not have to *lack* water to suffer. Too much water at the wrong time in the form of a flood can cause greater damage, and flooding towns and settlements is a time-tested tactic in warfare.

Finally, water itself is an attractive terrorist weapon. Not only can it cause great damage in large quantities, as mentioned above, but the ability of water to spread agents downstream makes it a perfect method of transporting poison or disease-causing agents such as *Cryptosporidium* bacteria. As an example of the economic and personal chaos this type of attack can cause, the April 1993 *Cryptosporidium* outbreak in Milwaukee killed more than a hundred people, affected the health of more than 400,000 more,²⁶ and cost \$37 million in lost wages and productivity. The outbreak was thought to be due to a combination of an improperly functioning water treatment plant and illegal pollution dis-

26. MacKenzie et al. 1994, 161.

charges upstream from the water intake point,²⁷ and not from a terrorist attack, but a similar outbreak in a large city such as New York or Chicago might cost billions and kill thousands of people.

An example of a resource-as-tool type of attack on a water resource site might be as follows. A terrorist hikes to a publicly accessible city reservoir such as Los Vaqueros, serving suburban San Francisco, and drops a certain amount of concentrated water-soluble contaminant (chemical or biological) near the intake pipe. In the best-case scenario, the contaminant is detected as it enters the water treatment plant, and the plant is shut down while the contaminant is neutralized. This can result in interruption of potable water service to the city and a "boil-water" alert for city residents. In the worst-case scenario, the contaminant is undetected and people begin to get sick, panic ensues, and health and economic damages soar.

Such scenarios are not purely hypothetical. Environmental resource-as-tool terrorism directed at water sites has already occurred. In July 2000, workers at the Cellatex chemical plant in northern France dumped 790 gallons of sulfuric acid into the Meuse River when they were denied workers' benefits. Whether they were trying to kill wildlife, people, or both is unclear, but a French analyst pointed out that this was the first time "the environment and public health were made hostage in order to exert pressure, an unheard-of situation until now."²⁸ Leaving aside the question of whether or not the workers would be considered terrorists, they certainly appear to have committed a terrorist act, since there was no way to isolate the effects of the acid from the general population, nor did they attempt to do so. As mentioned above, rivers and water supply infrastructure such as reservoirs are particularly vulnerable to this type of environmental terrorism, since they are publicly accessible in many places.

More common than these kinds of attacks are "resource-as-target" attacks on water resources. One such attack might involve a large hydroelectric dam on a major river. Terrorists equipped with a relatively small conventional explosive might not be able to cause serious structural damage to the entire dam, but they might be able to flood the dam itself and interrupt power generation. Alternatively, damage to the spillway gates could cause significant downstream flooding.²⁹ On July 17, 1995 a spillway gate at Folsom Dam broke under the weight of heavy flooding, pouring 40,000 cubic feet of water per second from the Folsom Lake reservoir into the American river and forcing the quick evacuation of fishermen, rafters and other recreationists, and homeless people living along the river banks.³⁰ It took six to ten days for the water level in Folsom Lake to go down so that the spillway gate could be fixed, during which time 400,000 acre-feet of water were released downstream, draining Folsom Lake of 40% of its

27. Smith 1994, 1.

28. *Christian Science Monitor*, 21 July 2000, 8.

29. James Mumford, Director of Safety Programs, Northwest Region, US Bureau of Reclamation. Personal Communication, 31 January 2001.

30. *San Francisco Chronicle*, 18 July 1995, A1.

capacity. This amount could have supplied two million people with water for one year.³¹ A similar incident occurred in early January 1997, when heavy rains overtopped the Don Pedro reservoir. Filled to 100% capacity, water operators had to open the spillway and let out flood waters at a rate of 35,000 cubic feet per second, 3½ times the capacity of the downstream rivers and canals.³² While neither of these incidents were terror-driven, they illustrate how much damage can be unleashed by manipulating an environmental resource. Flooding is not the only outcome. After the immediate flood pulse, there are water quality problems, as water treatment plants are overwhelmed. Fresh water supply is lost, as is hydroelectric power, commercial fisheries and recreation. Intermediate flood damage is possible if buildings remain in the flood plain. Finally, there is the expense of rebuilding the dam.

This type of resource-as-tool attack is also already occurring. In July of 1999, engineers discovered a homemade bomb in a water reservoir near Pretoria, South Africa. The dam personnel felt that the 15 kg bomb, which had malfunctioned, would have been powerful enough to damage the 12 million liter reservoir, thereby depriving farmers, a nearby military base, and a hydrological research facility of water. Police recognized this action as deliberate sabotage and began searching the country's other reservoirs for similar devices.³³ Even a simulated terrorist attack on a water resources site, the destruction of the Lake Nacimiento Dam, caused some panic in central California until the media was notified that the situation was merely a disaster preparedness drill.³⁴ And most recently, Palestinians attacked and vandalized water pipes leading to the Israeli settlement of Yitzhar³⁵ to force the Israelis out of the settlement.

Agriculture and Forest Sites

Forests and agricultural sites have not generally been identified as terrorist targets, but attention to this kind of target is growing, and the economic and political repercussions of damaging or destroying such a site can be significant. RAND terrorism expert Peter Chalk recently pointed out that such "agro-terrorism" can have devastating economic, environmental, and human health effects, and the USDA has allocated \$39.8 million to examine this problem.³⁶ Forests and farmland are vulnerable to destruction by fire or commercially-available herbicides, which can destroy both the growing crop(s) and render the land incapable of regeneration. While it is debatable among scholars whether or not the application of Agent Orange during the Vietnam War was a terrorist act,

31. *San Francisco Chronicle*, 19 July 1995, A1.

32. *San Francisco Chronicle*, 6 January 1997, A1.

33. *Pretoria News*, 21 July 1999, 1.

34. *San Francisco Chronicle*, 27 October 2000, A1, A23.

35. *Jerusalem Post*, 9 January 2001.

36. *Jane's Americas News*, 9 February 2001, as found at www.janes.com/regional_news/americas/new/jir/jir010209_1_n.shtml.

since it made no distinction between the Viet Cong and non-combatants, Operation Ranch Hand destroyed 36% of the mangrove forest area in South Vietnam and without extensive reseeded, it will not return to its natural state for perhaps a century.³⁷

Weaknesses of agriculture/forest sites include lack of natural borders, allowing fire or pathogens to spread from the targeted area to other areas. Depending upon the specific site, natural borders like roads and lakes are infrequent. Fires can even cross barriers such as roads when fanned by high winds, and dry weather conditions can make forests, fields, and grasslands more susceptible to fire. In addition, certain resources such as old growth forests may have historical and prestige value above and beyond what ecosystem services these resources provide. California's redwood trees, for example, are thousands of years old and their destruction would entail a far greater loss than just the timber revenue.

A hypothetical resource-as-tool attack on an agriculture/forest site might be crop poisoning. A well-known example of this type of attack was the cyanide poisoning of some Chilean grapes in 1989. While this particular incident caused no identifiable sickness, it was psychologically and economically effective: it caused panic in supermarkets and ultimately cost the Chilean fruit export industry millions of dollars in lost revenue by destroying consumers' trust. Just before Christmas in 1994, over \$1 million damage resulted from the threat of poisoned turkeys in Vancouver, British Columbia.³⁸ Psychological effects aside, poisoning a crop during processing would be much more physically efficient and would reach many more potential targets. In addition, the increasing use of genetically modified crops could result in a transgenic agent being introduced into the germline of a particular crop, contaminating it on a permanent basis.

A disturbingly common resource-as-target attack on an agriculture/forest site might be a wildland fire set in a national forest. Forest fires can cause significant damage. In May 2000, a prescribed burn in the forest near Bandelier National Monument burned out of control and threatened the Los Alamos National Laboratory and the nearby town of Los Alamos, resulting in the evacuation of 25,000 people.³⁹ The fire ultimately destroyed 47,650 acres, 220 houses and buildings, and resulted in a total damage estimate of \$1 billion, for which the federal government was forced to compensate local residents \$661 million.⁴⁰ A fire set near a major city (e.g., Arapahoe National Forest, near Denver; Angeles National Forest, near Los Angeles; or Tonto National Forest, near Phoenix) could result not only in loss of recreational use and possible timber revenue (lumber sales and replanting costs), but also in additional economic and

37. Buckingham 1982.

38. Smith 1998b.

39. CNN, 7 June 2000, as found at www.cnn.com/2000/US/06/07/control.fires.02/

40. ABC news, 20 May 2000, available at: abcnews.go.com/sections/us/DailyNews/alamos000520.html; and ABC news 21 July 2000, as found at abcnews.go.com/sections/us/DailyNews/alamos000720.html.

human health damage to city residents from evacuation, smoke inhalation, and fire-related property damage, as well as subsequent post-fire flooding.⁴¹

In a recent Report to the President, the Departments of Interior and Agriculture pointed out that the wildfires of 2000 were particularly fierce for two reasons. First, a severe drought across much of the country resulted in particularly dry ground conditions, and second, more than a century of aggressive wildfire suppression policy has led to a large build-up of dead trees, brush and other fuel.⁴² As early as 1995, the Departments of Agriculture and Interior issued a policy statement that “predicted serious and potentially permanent environmental destruction and loss of private and public resource values from large wildfires . . . Conditions on millions of acres of wildlands increase the probability of large, intense fires beyond any scale yet witnessed, . . . These severe fires will in turn increase the risk to humans, to property, and to the land upon which our social and economic well-being is so intimately intertwined.”⁴³ The wildfire risk is compounded by population growth in the nation’s most forested states, and increased development along forest boundaries,⁴⁴ making a forest fire a very attractive terrorist tactic.

Forests and agricultural sites have generally suffered greatly as environmental casualties during war, but have not often been sought out specifically as terrorist targets. However, they have served as resource-as-target sites for repercussions in civil conflicts. Recently, the ethnic Oromo minority in Ethiopia has claimed that the Ethiopian government set virgin forests afire in its territory to pressure the group into withdrawing demands for autonomy.⁴⁵ As recently as November 2000, the Israeli army destroyed over 400 olive trees belonging to Palestinians in response to Jewish settlers’ claims that rock-throwing children were using the trees as cover.⁴⁶ This destruction clearly had an economic impact on the Palestinians as well. Such precedents contribute to the perception that these sites are valuable targets.

Mineral and Petroleum Sites

Sites involving non-renewable resources with high economic value make attractive targets for violence of every kind. Oil refineries serve as attractive military targets during wartime, depriving the enemy of energy. Vulnerable areas of mineral and petroleum sites include the extensive and necessary infrastructure for the processing and transportation of the resource. Oil derricks, wellheads, pipelines, loading terminals, and tankers are all vulnerable to fire or conventional

41. Soot left on the forest floor from wildfires repels water and can keep the ground from absorbing rainwater (AP, 20 May 2000).

42. Forest Service 2000, 3, as found at www.fs.fed.us/fire/nfp/president.shtml.

43. *Ibid.*, 6.

44. *San Francisco Chronicle*, 30 May 2000, A3.

45. “Politics of Forest Fire,” *The Sidama Concern*, March 2000. Available at www.sidamaconcern.com/scfiles_news/sidama_politics_of_forest_fire_51.htm.

46. *San Francisco Chronicle*, 29 November 2000, C2.

terrorist explosives. Attacks on this infrastructure can create extensive environmental damage before being contained. In addition, oil spills can interfere with the normal workings of power stations and desalination plants by fouling intake water.⁴⁷

Mineral and petroleum sites are also particularly attractive targets because of the necessity of the resource to the health and growth of the national economy. Fossil fuels in particular have no readily available substitutes, especially on short notice and in necessary quantities.⁴⁸ An attack on a loading terminal at a main oil field can halt commerce for weeks, causing shortages in fuel and natural gas, and costing millions of dollars in higher prices. An attack on a site where a strategic metal is mined (e.g., vanadium or tungsten) can cause economic damage, and possible strategic concerns, by forcing mine customers to buy necessary supplies on the less-reliable and often more expensive spot market.

Oil pipelines in Colombia have regularly been the targets of attack. In 1997, over 45 separate attacks on the Cano Limon-Covenas pipeline, reputedly by leftist guerrillas from the National Liberation Army (ELN), caused Colombia's national oil company Ecopetrol to declare *force majeure* on all exports from the Cano Limon field.⁴⁹ In 1998, the ELN bombed the OCENSA pipeline, spilling over 30,000 barrels of oil and triggering a blaze that killed more than 70 people when the fire spread through nearby villages.⁵⁰ The Trans-Alaska pipeline has had its share of attention: an episode of the TV drama "Seven Days" included a terrorist attack on the pipeline, and in August of 1999, the Royal Canadian Mounted Police arrested a man in British Columbia who had planned to bomb the pipeline out of political and financial motives.⁵¹

Categorizing the attacks as resource-as-tool or resource-as-target attacks is sometimes difficult for these types of sites: a single attack can have both types of consequences. For example, a hypothetical mineral and petroleum site for an environmental terrorist attack would be the Alaskan oil fields. An exploded pipeline or wellhead would not only waste the oil (resource-as-target terrorism), but would befoul the delicate and fragile Arctic ecosystem (resource-as-tool terrorism). The most obvious example of the crippling disruption resulting from such an attack is the destruction of the Kuwaiti oil fields at the end of the Gulf War. While it remains debatable as to whether this was true terrorism or a legitimate act of war, the damage done from this attack was almost incalculable: approximately 6 million barrels of oil were burned *per day* until all the well fires

47. Dabbs 1996, 2.

48. Alternative energy sources are limited; after Three Mile Island and Chernobyl, nuclear power has never been fully embraced by the public as a safe method of energy, and renewables such as hydro, thermal, and wind power are limited by the generating capacity of current technology.

49. Energy Information Administration 2001.

50. *Golob's Oil Pollution Bulletin*, 27 November 1998, 5.

51. *Albuquerque Tribune*, 24 August 1999, available at www.abqtrib.com/y2k/082499_y2k.shtml; and *National Post*, 24 December 1999, available at www.nationalpost.com/content/features/millennium/122499mill4.html. According to accounts, he planned to buy oil and gas futures before the end of the year, bomb the pipeline (which he hoped would be blamed on a Y2K foul-up), then reap large profits after the resulting fuel shortage caused oil and gas prices to rise.

were capped, and the people of Kuwait suffered health and ecological problems for years afterward.⁵²

Wildlife and Ecosystem Sites

Natural ecosystems are probably the least likely to be identified as terrorist targets. However, the damage that can be done at such sites rivals only water resource sites for gravity and long-lasting effects. Any ecosystem attack has multiple repercussions, and wildlife-intensive sites are vulnerable to perturbation and habitat destruction. These resources are damaged by killing wildlife outright, or by destroying or rendering unsuitable its habitat. This type of terrorist attack can occur in conjunction with other types (e.g., a forest fire not only renders the timber useless, but destroys a mature ecosystem and deprives species of habitat). The vulnerabilities of wildlife sites include the endangered status of species residing there, and the cultural heritage considerations that attach themselves to specific species, such as California redwood trees or Koalas.

While not common, examples of this type of ecosystem attack do appear. In the Galapagos Islands, 600 miles off mainland Ecuador, local fishermen angry at catch restrictions killed dozens of internationally protected Galapagos tortoises in 1996.⁵³ In May 2000, the fishermen made a threat uniquely dangerous to the delicate and complex ecosystem of the Islands: they threatened to release birds, cats, goats, and weed seeds on the islands if their demands were not met.⁵⁴ This is a particularly dangerous threat, and not an idle one. The inadvertent introduction of zebra mussels in the Great Lakes in the mid-1980s has fouled raw water intakes along the coastline, altered the energy balance of lakes and streams, caused extinction of other aquatic species, and disrupted navigation, boating and sport fishing all through the Great Lakes. The US Fish and Wildlife Service has estimated damage so far at \$5 billion and Congress has spent \$150 million on methods to eliminate them or control their spread, unsuccessfully.⁵⁵ Ecosystem destruction such as that threatened by the fishermen may be so severe that the area may be damaged beyond recovery.

Island archipelagos such as the Galapagos are not the only type of ecosystem vulnerable to terrorist attack. Coral reefs present another extremely attractive target. The International Coral Reef Initiative estimates that ten percent of coral reefs worldwide are now degraded beyond recovery, and another 30 percent are on the verge of significant decline.⁵⁶ More are being destroyed every year by fishing and coral mining. Weakened as they are by routine economic activity, a physical attack against a reef with poison or dynamite could severely impact a country's economic base. Similarly, the destruction of an endangered species, if

52. Hawley 1992, 14, 110ff.

53. *Globe and Mail*, 19 October 1996, D6.

54. *San Francisco Chronicle*, 10 December 2000, A27, A34.

55. Ludyanskiy et al. 1993.

56. NOAA 1994.

concentrated in a few locations would result in a symbolic loss, if not a strategic or economic one.

Recommendations for Reducing or Managing Security Threats

In order to reduce the damage that can result from environmental terrorism, resource managers and security officials will have to consider new ways to deter terrorism and to protect natural resources. In combating environmental terrorism, democracies face civil rights obstacles that more authoritarian states do not. Since draconian crackdowns on the population are not acceptable,⁵⁷ liberal states may take specific legal steps to address more specifically the threat of environmental terrorism. Terrorists are currently treated as criminals, and the political aspects of their acts are often ignored. A clear example of this occurred just after the September 11 New York and Washington attacks as every American TV station and newspaper asked repeatedly, "How could anyone do this to us?" The reality, however, is that American policies and action abroad have earned the enmity of many people.

In addition, until recently, environmental crimes were ill-defined and not often prosecuted. Specific anti-ecocide laws would punish environmental terrorists under the criminal code while making clear society's condemnation of environmental destruction.⁵⁸ Likewise, there may be circumstances related to the scope or severity of attack under which extraterritorial application of domestic counter-terrorism law is applicable and appropriate.⁵⁹ This would allow the United States and other countries victimized by environmental terrorism to extradite terrorists or take other protective measures outside their own borders.

An alternative step would be the explicit reclassification of "terrorism" from crime to acts of (unjust) warfare. This appears to be the direction in which President Bush is taking the United States: bringing military resources to bear on terrorist apprehension and other counter-terrorism preparation. Terrorists could be tried under military justice.⁶⁰ Terrorism expert Walter Laqueur points out that "many terrorist groups have without hesitation attacked the police and, of course, civilians, but have shown reluctance to attack the military. They must have assumed that the military would be a harder target and that there would be massive retaliation."⁶¹ However, the reclassification of terrorism from crime to war has an ideological downside. Aside from the social repercussions of restricted civil liberties a terrorist is currently a criminal—a vandal, perhaps a murderer, but still a criminal. By calling terrorism "war," terrorists are elevated to the status of soldiers and their grievances are legitimized as battles worth fighting and dying for.

57. Wilkinson 2000, 38; *New York Times*, 12 December 2001, A1.

58. Schofield 1999, 620.

59. Raimo 1999, 1490.

60. Crona and Richardson 1996, 354–355.

61. Laqueur 1999, 37.

However, the explicit involvement of the military in the responsibility for counter-terrorism preparation and response raises its own major concerns about the diffusion of responsibility. Already there are approximately 40 federal agencies involved in counter-terrorism response, led by the FBI and including the CIA, the EPA, the DOE, and others. Making counter-terrorism preparation and response another Operation Other Than War (OOTW) responsibility of the military further muddies the water with regard to civilian authority and speed of response. Furthermore, the United States has always made an effort to separate domestic law enforcement from military involvement. While domestic OOTW assignments for the military usually involve disaster relief, using the military as law enforcement means crossing the boundary between civil and martial law, something democratic societies do not tolerate in non-emergency situations.

Regardless of the agencies or laws that are involved, successful counter-terrorism preparation can only be enhanced by more communication between terrorism experts and more specific recommendations to federal, state, and local policy-makers. The Gilmore Commission, a congressionally-mandated counter-terrorism advisory panel, has recently issued its second annual report, and first among its key functional recommendations is the call for enhanced sharing of terrorism intelligence, threat assessments, and other information.⁶² This information sharing should include research on choice of terrorist targets, not just motivation or type of weapon. Further research questions may include how to clarify the differences between crime, terrorism, and warfare, since the quasi-criminal, quasi-military nature of terrorism tends to blur these distinctions,⁶³ and an examination of which particular places around the world will be vulnerable to environmental terrorism.⁶⁴

Finally, the most reliable way for a nation to protect itself against the disruption caused by environmental terrorism is to diversify resource use wherever possible. Multiple sources of food, water, and energy mean each individual source is less attractive as a target, and equitable distribution of resources among users contributes to reducing tension over resource scarcity. This may decrease the political motivation of terrorists who take action on behalf of the "oppressed." In addition, federal, state, and local governments can protect environmental resources *in situ* through more intensive and focused monitoring efforts, in conjunction with increased environmental data gathering, a sort of "early-warning" system to identify future environmental risks.⁶⁵

As this paper goes to press, acts of purposeful environmental destruction continue,⁶⁶ and the current climate has given rise to fears of further attack: security has been stepped up at water and energy facilities all over the United

62. Gilmore Commission 2000, ix-x.

63. Devost et al. 1996, 2.

64. Chen et al. 1997.

65. William A. Nitze, 16 January 1997, Office of International Activities, Environmental Protection Agency. Speech before the World Affairs Council. As found at www.epa.gov/oia/sp8.htm.

66. For example, *Environment News Service*, 5 February 2001, available at ens.lycos.com/ens/feb2001/20011-02-05-01.html.

States.⁶⁷ Terrorism itself is a constant and fearful phenomenon, as America has learned to its recent and terrible cost, and like the nine-headed hydra of ancient mythology, as soon as one group or method is terminated, more spring up to take its place. The choice of environmental resources as targets or tools of terrorism is consistent with both the increasing lethality of terrorism and the growing environmental awareness on the part of the public.⁶⁸ The prevention of environmental terrorism will require a new vigilance: it calls for a new understanding of both the nature of the threat, and the formulation of appropriate and effective responses.

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67. *Chicago Tribune*, 23 September 2001, 1; *San Francisco Chronicle*, 21 September 2001, A19, A21; and *San Diego Union-Tribune*, 19 September 2001, A3.

68. Centner 1996, 75.

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