Ecology, Security, and Change in the Anthropocene

SIMON DALBY
Professor of Geography and Political Economy
Carleton University

RECENT INNOVATIONS IN EARTH SYSTEM science have added compelling arguments for the integration of environmental matters into security policy. Concerns about scarcity in the global South and conflicts over resources are now being overtaken by worries about global climate change and the vulnerabilities of populations to ecological disruptions. The sheer scale of human activity has lead to the designation of the contemporary era as a new geological period—the "Anthropocene"—in which ecological disruptions and vulnerabilities are caused increasingly by human actions. Thus, security planning needs to emphasize the importance of reducing the total throughput of materials and energy in the biosphere to limit disruptions while simultaneously building resilience and habits of international cooperation into human societies to better cope when disaster strikes.

ENVIRONMENTAL SECURITY

Initial debates about global environmental problems in the 1970s focused on population growth, endangered species, toxic chemical pollution, and various resource shortages. As the cold war drew to an end, many of these themes reemerged in international politics as they related to environmental security, water wars, and the potential for scarcity-induced conflict. As climate change now focuses attention on matters of environment, security is once again linked to the discussion, but the earlier *environmental* focus on toxic pollution, preservation of non-human species, and resource shortages is now being supplemented by a larger understanding of humanity as endangered by its changing ecological context. Recent developments in earth system science provide

SIMON DALBY is a professor in the Department of Geography and Environmental Studies at Carleton University in Ottawa. He is the author of *Environmental Security* and coeditor of *Rethinking Geopolitics* and *The Geopolitics Reader*.

compelling reasons to update the earlier discussion and reconsider how we now think about global security.

Unlike early environmental security research, which was concerned that scarcities in the global South might cause wars between the North and South, subsequent work has made clear that such a situation is not very likely.[1] More plausible dangers lie in potential civil wars in the South over the control of the rent streams from relatively abundant resources rather than from environmental scarcity, and from the depredations of political elites rather than from the poverty of marginal peoples.[2] As the prospect of "peak oil" looms once again, these matters of resources and conflict are being discussed in geopolitical terms.[3] Most recently, and especially in the aftermath of the severe hurricane season of 2005, new questions are being asked about human vulnerabilities as a result of climate change.

Growing concern over human vulnerability corresponds to the shift in the earth sciences over the last decade. Science has enabled us to recognize that we live in a single, interconnected biosphere, one that humanity is changing as it becomes an urban species increasingly powered by fossil fuels. Earlier environmental concerns regarding the dangers of industrial pollution, the need for resource and wildlife conservation, and even Malthusian concerns about population are being overtaken by a global perspective that emphasizes the ecological connections among phenomena and between humanity and its environment.

The sheer scale of human activity is changing the biosphere in quite dramatic ways. The much-quoted line from Genesis about humanity having dominion over nature can now simply be read as a statement of fact.[4] The world is effectively no longer "wild." But, in "conquering nature," we have fundamentally changed it through urban industry, such that the categorical distinctions between humanity and nature are no longer very useful in discussing either the future or how we might arrange social and political matters.[5] The artificial habitat we are collectively constructing—often inadvertently—is now the appropriate context for environmental security discussions.

The sheer scale of human activity is changing the biosphere in quite dramatic ways.

This scientific update should be incorporated into security thinking. Such an approach starts with a summary of the Anthropocene era and then reflects on the intellectual limitations of contemporary security concepts in application to new earth–systems thinking. Among other things, we need to understand globalization as a new ecological process that threatens to drastically alter the planetary climate.[6] While such principles are essential to rethinking how environmental security is viewed, implementing these in practice is not going to be easy unless the implications of earth system science are taken very seriously.

The Anthropocene

Many scientists suggest that we now live in a new era of natural history—the Anthropocene—where human activities have introduced new biophysical factors into the biosphere and have begun to change the physical parameters that determine the functioning of the major earth system processes, most noticeably the composition of the atmosphere. In the words of authors from the International Geosphere Biosphere Program:

> Crucial to the emergence of this perspective has been the dawning awareness of two fundamental aspects of the nature of the planet. The first is that the Earth itself is a single system, within which the biosphere is an active essential component. In terms of a sporting analogy, life is a player, not a spectator. Second, human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and accelerating ways; humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, upon which humans depend.[7]

In terms of the sciences of climatology, geochemistry, geomorphology, and ecology, it is no longer appropriate to think only in terms of "natural" mechanisms to understand the processes that shape our habitat.[8] An obvious example is atmospheric change due to human pollution. However, climate change and atmospheric levels of carbon dioxide are not the only changes that matter. The artificial fixing of nitrogen, the rapid increase in human appropriations of "natural" productivity, the extinction of avian and mammalian species, and the fishing down of the oceanic fish stocks are all human changes in environment, the effects of which interact in fashions that are not yet fully understand. The effect of one change often interacts with another environmental factor in non-linear ways which will produce surprises in the future. We simply do not know where the critical thresholds are, although we discovered one relating to ozone depletion in the 1980s quite by accident.

There may well be negative feedback systems that counteract some of the perturbations, as in the case of jet aircraft emissions effectively shading the planet from the worst effects of carbon dioxide warming, but there is no reason to believe that in the aggregate these cascading interconnections will be benign to the current arrangements of human civilization.[9] Those who choose to ignore the warning signs are in fact betting that at least the rich and powerful parts of our species can use technology to evade the consequences of these changes. But this appears a very dubious wager to those studying contemporary ecological processes.

Human population has grown tenfold in three centuries, most noticeably in the twentieth century. How we live and the demands we make on ecological systems have

changed dramatically, too.[10] Cows, long held to be a major food source, now number nearly 1.5 billion, and they too have to be fed. Most major rivers have been dammed. Tropical forests are disappearing rapidly. Fossil fuel consumption now puts at least twice as much sulfur dioxide into the atmosphere as natural processes do. Fisheries are removing up to one-third of the primary biological production of the seas and are causing great concern about the eradication of key fish species as a source of protein for many people. More nitrogen is artificially fixed from the atmosphere to make fertilizer than occurs in all the natural processes combined. In terms of the sheer volume of material in motion on the surface of the planet, trucks, trains, pipelines, bulldozers, tankers, and freighters now count as geomorphological agents—moving mountains, filling in lakes, extending coastlines, and diverting river flows. Numerous species and ecosystems are being destroyed, disrupted, and displaced by human activities. Agricultural activities have long cleared wilderness and diverted water to irrigate fields, but the more recent mining operations, highways, ports, cities, and other activities are also producing artificial ecologies.

An example of the efforts taken to counteract human changes to the environment is the effort to preserve biodiversity, which is crucial to the long-term habitability of the biosphere—only species that are alive can adapt and colonize new ecological niches. Most recently, attempts to preserve endangered species emphasize the protection of their habitat. But it is now clear that it is not only important to protect habitats for numerous species, but also essential to connect ecological spaces so as to facilitate migration in the face of environmental change. Only now are roads, cities, and fields beginning to be understood as ecological obstacles to migration and habitat expansion.

Climate change is another effect of the rapid human population growth that is only now beginning to be fully understood. Contemporary debates about environmental change usually highlight the changing composition of the atmosphere, such as the doubling of methane and the 30 percent growth of carbon dioxide concentrations. Such gases have now reached levels that are higher than at any point in the past 400 millennia.[11] Given the general pattern of correlation between the level of carbon dioxide and atmospheric temperatures, this is cause for great alarm.[12] As a result of our carbon fuel combustion, we are off the scale of the known geological record of atmospheric gas concentration for the last few hundred thousand years. There is reason to believe that we may be in for a period of dramatic climate change shortly; the evidence that it has already begun is accumulating rapidly.[13] In the polar regions, which are especially sensitive to climate changes, scientists watching polar ice sheets now consistently report their breakup.

The recent stratospheric ozone depletion is a salutary warning about the possibilities of the surprises and dangers of rapid climate shifts. One conceivable scenario could

result from temperature and salinity changes in the North Atlantic.[14] Currently, cold water sinks into the ocean's depths to be replaced on the surface by water flowing in from the Gulf Stream, forming a conveyor belt of warm water that keeps Europe relatively warm and allows agriculture in the north of Scandinavia. If the water temperature warms and the salinity changes, then these waters may not sink, and the conveyor belt may cease to function, likely precipitating dramatic climate shifts. A common agricultural policy might then be the least of European Union's worries. While changes at the speed depicted in the 2004 Hollywood disaster movie *The Day After Tomorrow* are not plausible, other unanticipated disruptions are.[15]

From Environment to Ecology

Arguably the last half-century has presented many environmental concerns requiring global responses, so this discussion of the Anthropocene is nothing new. But an understanding of the Anthropocene era demonstrates that climate concerns interact in all sorts of synergies that must be examined cumulatively rather than individually.[16] In that sense, "the environment" as a simple category of concern has also been transcended; the preservationist and romantic premises of old environmentalism are undercut by both the scale of human activity and growing understandings of the ecological changes that are occurring.

Environmentalist tropes of pristine nature suggest the importance of minimizing human alterations of natural habitats. But now that so many habitats are obviously already altered, the preservationist ethos is frequently inappropriate if ecology, rather than aesthetics or tradition, is considered as the basis for policy prescription.[17] The primary goal must now be reducing the overall burden of human ecological activity by looking to reduce the materials and energy used in the economic system,[18] so as to minimize the disruption of natural cycles and enhance the possibility of adapting to new ecological circumstances. The move away from the preservationist ethos is a break from traditional environmentalism. Ecology as advocacy in the Anthropocene is not about parks and protection; it is about changing the modes of production and consumption to reduce total ecological throughput in the biosphere for sustainable human existence. Grasping the totality of material transformations is the pressing priority. Ecology has a global politics, one that has to recognize environments as actively constructed on various scales by their human inhabitants. Claims of a universal morality and some responsibility to care for the earth in earlier environmentalist formulations are being powerfully reinforced by earth system science. The liberal economic assumptions of ever-growing material accumulations for autonomous consumers—the logic of consequence-less consumption—are no longer tenable despite the protestations of

the Julian Simons and the Bjørn Lomborgs that economic trends predict continued improvement for humanity.[19]

Earlier assumptions about environmental degradation both confuse science and environmentalism and connote a mistaken linear causation.[20] Environmental change is not a simple matter of degrading a given environment. Change may be disruptive and dangerous, but it is part of ecological existence. Many ecosystems can recover from disruptions, but only if their larger context remains mostly intact and if species can move to re-inhabit disrupted areas. If not, then new ecological arrangements—which may not be nearly as useful to their human inhabitants—will inevitably arise.

The trick now is to understand that biophysical reality as a process that includes humanity. To reduce the dangers of unpredictable disaster while enhancing human security in these circumstances requires simultaneously reducing the human use of materials and energy in order to reduce the speed of ecological change. Total ecological throughputs can be reduced by careful management and technological substitutions.[21] At the same time, building human systems that are resilient and not dependent on long and vulnerable supply lines for the essentials of life will facilitate coping when disaster strikes. Clearly, this needs to be complemented by robust emergency preparedness and public health systems both nationally and internationally.

The collapse of any credible distinction between humans and nature forces humanity to modify ethical codes or political aspirations so as to no longer rely on simple models of autonomy and separation. The historically acceptable assumptions about the earth as the given home for humanity no longer hold. Many of humanity's changes to the biosphere have yet to show dramatic manifestations, but they are coming as a consequence of past human activities. They will not necessarily be malign or benign, but they will likely be unpredictable, and their consequences will be unevenly felt by people depending on the particular context in which they live.[22]

Increasingly, we are constructing the context for our lives at the very biggest of scales: the planetary biosphere itself. There are no guarantees that we will collectively make a biosphere that remains conducive to the type of civilization in which we might like to live, but as Jared Diamond notes in the conclusion of his book *Collapse*, we have the benefit of learning from previous societies' failures to deal with changing environmental circumstances.[23] On the other hand, previous societal collapse has been on a much smaller scale. Now, due to the degree of human interconnectivity in the global economy, our predicament is truly planetary. Adapting our modes of thinking to these lessons is crucial.

The most important ecological processes are rarely contained neatly within the administrative boundaries of states, yet state-based politics and spaces are appropriate paradigms for the human side of environmental matters.[24] Understanding the connections between the supply and disposal of commodities consumed in urban centers is key to reducing the throughput of energy and materials while simultaneously building ecological resilience into social systems so that they can deal with disruptions.[25] Political leaders must move from mitigation and regulation after the fact to thinking seriously about design and construction of artifacts, technologies, and societies that minimize ecological throughput. The technical dimensions of all this are probably easier to tackle than the social ones, not least because of the powerful persistence of all sorts of social hierarchies that are now marked and perpetuated by consumption practices.[26] Understanding ourselves primarily as citizen–consumers within the boundaries of nation states is a fundamentally misleading conception. Political assumptions of autonomy at the scale of either the individual or the state are no longer tenable. Understanding the ecological consequences of our actions betrays the extreme folly of such heroic individualism fostered in contemporary commodity culture.

The most important ecological processes are rarely contained neatly within the administrative boundaries of states.

In the terms of the British government's 2006 *Stern Report* on the economics of climate change, there is a pressing necessity to deal with the current system's market failures.[27] Pricing of contemporary commodities does not include any indication of the externalities that matter on the global scale, such as lost habitats and the future disruptions resulting from atmospheric change. As such, the market system does not incorporate key factors in how it allocates resources. The future availability of resources is simply assumed. The evidence from earth system science suggests clearly that relatively stable climatic conditions, and the biodiversity needed to adapt to unpleasant surprises in the future may not be there.

Some initiatives driven by consumer boycotts and protests—as well as certification initiatives—push markets to undertake appropriate innovations, but clearly regulatory frameworks for incentive and appropriate taxation policies will also be necessary.[28] One huge benefit of the British *Stern Report* was that it finally focused attention on the costs of failing to implement innovations rather than on the supposed difficulties of regulation and change.

The contemporary tools of international relations are often not helpful in understanding these social and political relationships.[29] Starting from the premise of competing individuals and autonomous rivals, spatially delimited polities make eminently good sense to social scientists preoccupied with matters of public administration, national

identity, or matters of international relations in which state rivalries apparently require armies. But in light of the emerging understandings of earth system science, these starting points seem singularly inappropriate for discussing environmental security, not least because they so frequently take the material context of politics for granted. It is precisely this context that earth system science explains should not be taken for granted.

RETHINKING GLOBAL SECURITY

All of this suggests that a security policy worthy of the name needs to do three things immediately and simultaneously. First, it must reduce the total ecological disruption of the global system by making energy use and material consumption in the global economy more efficient. Second, a security policy must enhance the abilities of states and military forces to provide aid and assistance at short notice so that they can protect people and livelihoods when disasters happen. Third, as a logical extension from the second point, the policy must extend the habits and institutions of international cooperation so that aid and trade—rather than confrontation and conflict—are the responses to ecological disruptions.

These steps makes sense only if it is complemented by planned international cooperation. As the presence of Canadian rescue workers in New Orleans, the U.S. navy in Aceh after the Tsunami, and various European crews in Pakistan after its last major earthquake make clear, emergency help is now operating across boundaries, and non-conflict operations for militaries suggest all sorts of possible models of preparation for dealing with disruptions.[30] These could be greatly facilitated by advanced planning and simple innovations like immigration pre-clearance arrangements for emergency workers. Food aid in the event of disasters is also a possible response to storms and droughts.

It is worth emphasizing that these are becoming the normal responses, but that is not necessarily how they are discussed in the security literature. Three years ago, when a Pentagon scenario-planning exercise on rapid climate change attracted a flurry of media attention, an assumption buried in the middle of the report was that states would fight rather than trade in a crisis.[31] The assumption was not commented upon. As Daniel Deudney has long argued, traditional military thinking is frequently antithetical to the practical cooperation and innovative policies needed to deal with environmental difficulties.[32]

Overcoming the divides between science and politics, between culture and nature, and between urban and rural requires societies to build sensibly for the future rather than try to ground security politics in protecting things that will inevitably change. Invoking the theme of the Anthropocene emphasizes the importance of flexibility and adaptability, and the impossibility of complete certainties in our increasingly intercon-

nected world. Rather than perpetuating fears of disruptions caused by rural populations in the South or shortages of supplies essential for the functioning of Northern urban systems, security now has to be a matter of implementing ecologically appropriate building codes, intelligent land use, and emergency planning systems.

Notes

1. Thomas Homer-Dixon, *Environment, Scarcity and Violence* (Princeton: Princeton University Press, 1999).

2. Colin Kahl, *States, Scarcity, and Civil Strife in the Developing World* (Princeton: Princeton University Press, 2006).

3. P. Le Billon, *Fuelling War: Natural Resources and Armed Conflicts* (Oxford: Routledge; International Institute for Strategic Studies, 2005); P. le Billon "The Geopolitical Economy of Resource Wars," *Geopolitics* 9, no. 1 (2004): 1–28.

4. Eric W. Sanderson and others, "The Human Footprint and the Last of the Wild" *BioScience* 52, no. 10 (2002): 891–904.

5. J. R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: Norton, 2000).

6. D.C. Pirages and T.M. DeGeest, *Ecological Security: An Evolutionary Perspective on Globalization,* (Lanham, MD: Rowman and Littlefield, 2004).

7. International Geosphere Biosphere Program, "Global Change and the Earth System: A Planet Under Pressure," *IGBP Science,* 4 (2001): 4.

8. W. Steffen and others, *Global Change and the Earth System: A Planet under Pressure,* (Berlin, Heidelberg, New York: Springer-Verlag, 2004).

9. See Lance H. Gunderson and C.S. Holling, eds., *Panarchy: Understanding Transformations in Human and Natural Systems* (Washington: Island Press, 2002).

10. For a comprehensive assessment see Millennium Ecosystem Assessment, *Ecosystems and Human Wellbeing* (Washington: Island Press, 2005). A useful overview is contained in World Wildlife Fund, *Living Planet Report 2006* (Gland, Switzerland: WWF 2006).

11. Al Gore, *An Inconvenient Truth* (New York: Rodale Books, 2006). See the key analysis of the Vostok Antarctica ice core evidence in J.R. Petit and others, "Climate and Atmospheric History of the Past 420,000 Years from the Vostok Ice Core, Antarctica," *Nature* 399 (3 June 1999): 429–436.

12. J. Hansen and others, "Global Temperature Change," *Proceedings of the National Academy of Sciences* 103, no. 30 (2006): 14,288–14,293.

13. Stephen Schneider, "Abrupt Non-Linear Climate Change, Irreversibility and Surprise", *Global Environmental Change*, 14(3): 2004: 245–258.

14. Richard B. Alley, "Abrupt Climate Change," *Scientific American* 291, no. 5 (November 2004): 62–69.

15. Tim Flannery, *The Weather Makers: How We are Changing the Climate and What it Means for Life on Earth* (Toronto: Harper Collins, 2006)

16. H.J. Schellnhuber, P.J. Crutzen, William C. Clark, and J. Hunt, "Earth System Analysis for Sustainability" *Environment* 47, no. 8 (2005): 11–25.

17. Simon Levin, *Fragile Dominion: Complexity and the Commons* (Reading, MA: Perseus, 1999)

18. Helmut Schütz, Stephan Moll, and Stefan Bringezu, *Globalisation and the Shifting Environmental Burden: Material Trade Flows of the European Union* (Wuppertal: Wuppertal Institute for Climate Environment and Energy, 2004), http://www.wupperinst.org/globalisierung/pdf_ global/shifting_burden.pdf.

19. Julian Simon, *The Ultimate Resource II* (Princeton: Princeton University Press, 1996); Bjorn Lomborg, *The Skeptical Environmentalist: Measuring the Real State of the World* (New York: Cambridge University Press, 2001).

20. Philip Stott and Sian Sullivan, eds., *Political Ecology: Science, Myth and Power* (London: Arnold, 2000);

Nancy Peluso and Michael Watts, eds., *Violent Environments* (Ithaca: Cornell University Press, 2001).

21. Perhaps the most dramatic indication of the possibilities is the substitution of cell phones for landlines, which would dramatically reduce the amount of metals used in phone line infrastructure; the cables that are used now are mostly fiber optics, not metal.

22. D.G. Evan, Warren Mabee Fraser, and Olav Slaymaker, "Mutual Vulnerability, Mutual Dependence: The Reflexive Relation Between Human Society and the Environment," *Global Environmental Change* 13 (2003): 137–144.

23. Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Viking, 2005).

24. Warren Magnusson, and Karena Shaw, eds., *A Political Space: Reading the Global through Clayoquot Sound* (Montreal and Kingston: McGill Queen's Press, 2002).

25. Wolfgang Sachs, Reinhard Loske, and Manfred Linz, *Greening the North: A Post-Industrial Blueprint for Ecology and Equity* (London: Zed, 1998).

26. Thomas Princen, Michael Maniates, and Ken Conca, eds., *Confronting Consumption* (Cambridge, MA: MIT Press, 2002).

27. Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge, UK: Cambridge University Press, 2006).

28. Felix Dodds and Tim Pippard, eds., *Human and Environmental Security: An Agenda for Change* (London: Earthscan, 2005).

29. An argument I make at length in Simon Dalby, *Environmental Security* (Minneapolis: University of Minnesota Press, 2002) and in updated form in Simon Dalby, "Environmental Security: Ecology or International Relations?" in *International Ecopolitical Theory: Critical Approaches,* eds. Peter Stoett and Eric Laferrière (Vancouver: University of British Columbia Press, 2006), 17–33.

30. Gregory D. Foster, "A New Security Paradigm," *Worldwatch Magazine* 18, no. 1 (January/February 2005): 36–46.

31. Peter Schwartz and Doug Randall, "An Abrupt Climate Change Scenario and its Implications for United States National," Security Global Business Network, http://www.gbn.com/ArticleDisplayServlet.srv?aid=26231.

32. Daniel Deudney, "Environmental Security: A Critique," in *Contested Grounds: Security and Conflict in the New Environmental Politics,* eds. Daniel Deudney and Richard Matthew (Albany: State University of New York Press, 1999), 187–219.