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Conservation and Climate Change: The Immediate Need to Adapt

> I used to think adaptation subtracted from our efforts on [climate change] prevention. But I've changed my mind.
>
> —Al Gore, quoted in the *Economist*, September 11, 2008[1]

Over the past several decades, a global consensus has emerged around the need to address climate change through mitigation, dramatically slowing the release of so-called greenhouse gases into the atmosphere so as to forestall dramatic and disruptive impacts to the earth's ecosystems. The well-known argument for climate change related mitigation efforts generally goes like this: Unless we act in the next decade to slow the release of greenhouse gases into the atmosphere, our children and grandchildren, in the not-too-distant future, will face awful consequences, including rising sea levels, the spread of tropical diseases and destructive invasive species, and epochal damage to habitats that will endanger wildlife and rare species of plants around the globe.

Sadly, we are now seeing gathering evidence that the "not-too-distant future" is upon us. The disruptive impacts of climate change on ecosystems and their functions are being registered now. But the scientific and policy community has yet to systematically address how we might adapt to the consequences of climate

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change. A substantial effort needs to be taken immediately to design and implement strategies for adaptation to climate change.

Why have only limited efforts to grapple with adaptation to climate change been made to date? Up until recently, the conservation and environmental communities have largely seen the design of adaptation strategies as detracting from local, regional, and global mitigation efforts. In his 1992 book, *Earth in the Balance*, Al Gore argued, "Believing that we can adapt to just about anything is ultimately a kind of laziness, an arrogant faith in our ability to react in time to save our skin."[2] Pursuing adaptation, in other words, was seen as giving up the chase to reduce greenhouse gas emissions.

Yet despite some individual successes in mitigating the emission of greenhouse gases, we have hardly turned the corner on emission reductions. Rather, the growth in the level of emissions of such gases in the first half-decade of the twenty-first century more than doubled the growth level recorded in the 1990s, in part because of accelerating industrialization in developing nations such as China and India.[3]

DISRUPTIVE IMPACTS: FROM THE SUBTLE TO THE HIGHLY DRAMATIC

The disruptive impacts related to climate change on environment that are now being recorded range from the subtle and incremental changes to the highly dramatic transformation of entire landscapes. A casual observer of the impact of climate change in North America[4] might need a field biologist to explain the creeping influence of recent rises in sea level of just a few centimeters in estuaries on coastlines on the Atlantic, Pacific, and Gulf coasts. In places such as the Chesapeake Bay and along the outer coasts of coastal Virginia and North Carolina, slightly higher elevation sections of protected sanctuaries that had harbored fresh and brackish water fish and vegetation are now, with rising sea levels, being flooded with salt water.[5]

As a consequence of these subtle changes, wholesale ecological transformation is underway. Valuable habitat is being lost not only for the fresh and brackish ecosystem fish, shellfish, and native coastal grasses, but also for the remarkable migratory waterfowl that have depended on these fish for dinner during their epic migrations. While these ongoing changes may not be apparent today to the untrained eye, the forecast is that many millions of hectares of these coastal lands may become entirely submerged in decades to come.

Other climate change related impacts to terrestrial ecosystems in the early twenty-first century are much less difficult to discern, even to the casual observer. Consider the vast expansion of the range of pine beetles in western North America that is being facilitated by climate change, and the immense impact those beetles may soon have across the face of the continent.

Imagine a map of North America as the face of a clock, with an hour hand sweeping across the face that is unveiling a biological disruption of continental proportions. The clock's hour hand, as you may have guessed, pivots around a cen-

tral point somewhere in Kansas. It has already swept from about nine o'clock (that is, the pine forests in Colorado and Utah) to about eleven o'clock—which is to say the Canadian province of Alberta. That sweep of the hour hand, from Colorado and Utah to British Columbia and into Alberta, indicates the territory where the pine beetle has already decimated immense lodgepole and ponderosa pine forests.[6] You can color the area under the sweep of the hour hand red, not because of beautiful fall colors in the trees, but because that is the color of dead needles on dead and dying pines.

In British Columbia (BC) alone, the infestation has killed some 14 million to 15 million hectares of forest. The Alberta Minister of Sustainable Resource Development, Andrew Morton, who is himself trying to grapple with the challenge, estimates that"there are some areas in BC [where] you won't see a green forest again until 2050."[7] Andrew Nikiforuk, writing in *Canadian Geographic*, characterizes the mountain pine beetle (Dendroctonus ponderosae), as "the author of the worst insect infestation in North American history."[8]

The beetle has been enabled in its northward march by the rising winter temperatures associated with climate change. Warmer winter temperatures in high elevations allow it to reproduce in places where it had previously been frozen out. Because of rising winter temperatures, the vanguard of the beetle infestation has already crossed the formerly impenetrable barrier of the Rocky Mountains and is now well to the east of the continental divide. The vast expanse of the boreal forest, which stretches all the way to the Atlantic coastline in Labrador (from about 11 o'clock to 2 o'clock on our metaphorical clock) is at risk. A domino effect could be in store for the pine forests of the northeast United States (about 1 o'clock to 2 o'clock), followed by the diverse pine forests of the southeast (about 2 o'clock to 5 o'clock). The rotation may even extend to the 6 o'clock mark in east Texas and Mexico's Sierra Madre Oriental. At that point the North American circuit of the mountain pine beetle may be complete, for the simple reason that the continent's expansive pine forests do not extend across the southern reaches of the Great Plains.

The continent-circling spread of pine beetles constitutes but one grim scenario in a growing catalog of currently unfolding environmental disruptions associated with climate change. Indeed, the scientific literature is now rife with evidence of how wildlife is responding (or, sometimes worse, not responding) to climate change.[9]

THE EMERGENCE OF CLIMATE CHANGE ADAPTATION AS A CONSERVATION PRIORITY

With biodiversity already beset by threats ranging from habitat destruction to invasive species, how should conservationists respond to the challenge of climate change? The good news is that the conservation community is generally well informed about the real and potential impacts that climate change may have on species around the world. Most of the largest national and international conser-

vation organizations with a significant presence in the United States have already incorporated programs focused on climate change into their strategic plans, not to mention their educational and membership campaigns.

Yet these groups are still striving to decide where they should concentrate their climate change related efforts. As noted above, many already focus advocacy efforts on promoting mitigation to reduce anthropogenic greenhouse gas emissions. Such advocacy efforts include initiatives to advance international agreements, such as as-yet unsuccessful efforts to have the United States adopt the Kyoto Protocol or its emerging successors; programs to implement regional schemes, such as the Regional Greenhouse Gas Initiative, or RGGI (pronounced "Reggie") in the northeast United States; and a wide array of local initiatives sponsored by cities, villages, schools, and churches to reduce their greenhouse gas footprint. But as the spread of the mountain pine beetle and the widespread transformation of coastal estuaries illustrate, under even the most hopeful of mitigation scenarios, disruptive changes to the environment have and will continue to occur, most probably at an accelerating rate. Only in the past several years have major conservation organizations begun to deal with the immediate need to design and implement adaptation strategies.

In February 2007, for instance, a panel of eminent scientists, in preparation for a meeting of the United Nations' Commission on Sustainable Development, produced a report entitled "Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable." In the report, the lead authors, Rosina Bierbaum (Dean of the School of Natural Resources at the University of Michigan) and Peter Raven (Director of the Missouri Botanical Garden) highlight the inevitability of continued climate change. In the report's introduction, they make an unequivocal argument for pursuing both mitigation and adaptation strategies: "Because the climate will therefore be changing for many more decades, it is vital that adaptation strategies are adopted in parallel with aggressive mitigation strategies."[10]

Since that time, a growing body of work has helped to move forward the conservation community's grasp of the immediate need for adaptation strategies. For instance, at a workshop on the topic of Conservation and Climate Change held at the Lincoln Institute of Land Policy in Cambridge, Massachusetts in May 2007, a small group of senior executives and subject experts working in conservation organizations from the public, private, non-profit and academic/research sectors gathered to consider how to develop effective adaptive management strategies. At the conclusion of that meeting, the group decided that the issue was of such significance that it merited a second gathering in Washington, D.C. to frame the challenge of adaptive management for a larger audience of policy-makers, conservation leaders and their staff members.

The second meeting, attended by some 100 invited participants, was held in May 2008 at the Carnegie Endowment for International Peace in Washington, D.C.[11] Participants were charged with considering the following question: How can the land and biodiversity conservation community effectively devise and imple-

ment effective adaptive management strategies to address the ongoing impacts of climate change on conservation land and water resources, as well as agriculture and rural communities? In thinking through this challenge, the participants focused on a four-tiered approach to adaptive management that includes: (1) scientific observation, (2) planning and projection, (3) action in the field, and (4) periodic assessment. In addition, the participants considered ways in which the use of new markets, such as cap-and-trade markets to reduce greenhouse gas emissions, and ecosystem service markets that reward sustainable forestry practices, might facilitate the rapid implementation of effective adaptation strategies.

SCIENTIFIC AND MANAGEMENT RESOURCES CAN BE MOBILIZED

Participants in the May 2008[12] meeting learned that there are significant scientific and management resources in the public, private, and non-profit sectors that can be mobilized in the effort to adapt to climate change in the United States, should we as a nation prove to have the will to do so.

Scientific observations of the impact of climate change are already well underway, and could accelerate markedly in pace in the next several years. Such observations range from careful field studies of individual species to satellite scans of entire regions. Biologist Richard Primack has showed how inventive use of observations recorded by Henry David Thoreau in the 1850s give us a baseline for understanding the changes in flowering times of common plants over the past 150 years.[13] Continued observations of this nature could well engage citizen scientists across the continent.

Complementing such close-up study are continental-scale overviews of the threatened productivity of agricultural lands in the face of climate change induced temperature rises and an increase in severe storm events, as detailed by Tony Janetos[14] of the Joint Global Change Research Institute and Craig Cox of the Soil and Water Conservation Society.

The National Ecological Observatory Network (NEON), with the support of the National Science Foundation, is now laying plans to build a continental monitoring network that offer us the opportunity to track changes in ecosystem function at an unprecedented scale, scope, and level of detail in years to come. As described by the new organization's CEO, David Schimel, data generated by the network will offer an unprecedented overview of ecosystem function on a continental scale. When data generated by NEON is used in concert with the insights of ecosystem scientists such as Camille Parmesan, we are likely to have an increasingly "globally coherent fingerprint of climate change impacts across natural systems."[15]

How will we use those detailed observations? A growing number of scientists and field conservationists hope to use it to craft resource management plans that are robust under a range of possible scenarios. Jesse Logan, the insect specialist who has been instrumental in helping to bring the threat of pine beetles to public attention,[16] has recently used computer modeling to find locations that may still

offer cold enough winter temperatures to avoid pine beetle infestation. Such locations may be some of the most important places to conserve in the Rocky Mountain West.

In a similar vein, scientists at The Nature Conservancy are studying which coastal upland areas offer the best conservation opportunities in the face of rising sea levels along the Atlantic Coast in the United States. More recently, Botkin and his colleagues[17] have explored how to forecast broader biodiversity trends in light of climate change, and have offered the hopeful suggestion that "there is now much scope for an integrated framework for forecasting the impacts of global change on biodiversity."[18]

With careful planning in hand, conservationists have begun to implement several projects that are taking direct action in the field to adapt to the impacts of climate change. These range from The Nature Conservancy's work to protect areas such as North Carolina's Albemarle Peninsula, where TNC is eliminating old agricultural drainage ditches to reduce sea water infiltration into peat marshes,[19] to large landscape conservation initiatives such as the "Yellowstone to Yukon Conservation Initiative," which is attempting to protect a network of "core" protected areas and wildlife corridors for a region that stretches across nearly half of North America.[20] Dr. Lara Hansen, President of the newly-created firm EcoAdapt, is developing methods to train conservation land managers from around the world to experiment with and assess a variety of on-the-ground adaptation strategies that, for example, minimize human-animal interactions that are potentially dangerous to both people and wildlife at such varied sites as tiger sanctuaries on islands off the coast of India, coral atolls in the Pacific, and polar bear habitat in the Arctic.[21]

The implementation of even the most carefully crafted plans, of course, is never entirely sufficient. Ongoing assessment must be performed to ensure that well-intended field efforts have the desired effect. Unfortunately, often due to a lack of funding, a substantial amount of conservation work in North America suffers from a lack of ongoing independent assessment, or even frank internal review.[22]

There are notable and important exceptions to this state of affairs. In the Montana's Blackfoot River Valley, an initiative known as the Blackfoot Challenge has distinguished itself for efforts to reduce unwanted interactions between humans and the local grizzly bear population, which has in recent years been attracted to lower elevations in the valley because of the declining supply of food supplied by high mountain pines, which are being attacked by the pine beetle. The Blackfoot Challenge is known for crossing institutional boundaries to solve on-the-ground problems. Its participants include public agencies such as the U.S. Fish and Wildlife Service and the Montana Department of Fish, Wildlife, and Parks; non-profit collaborators such as Trout Unlimited and The Nature Conservancy; a broad coalition of private ranchers in the valley; and management insight provided by faculty from research and academic centers at the University of Montana and other universities. By using a multifaceted approach involving the removal of cat-

tle carcasses from area ranches, the lock-down of area dumpsters, and an extensive public education campaign, all of which are refined each year based on the previous year's results, reported human-bear interactions have been reduced by more than 90 percent since the early years of this decade.[23] This and other conservation efforts in the Blackfoot Valley, refined through extensive community consultation each year, earned the Blackfoot Challenge an Innovations in American Government Award from the Ash Institute for Democratic Governance and Innovation of the Harvard Kennedy School in 2006.[24]

In addition to essential face-to-face reassessments, adaptation efforts can also benefit from the use of satellite imagery to audit their impact. As has been noted in a previous edition of *Innovations*, the use of such technology can assist managers in keeping track of changes across wide swaths of forests, such as the 762,000 acre (about 308,000 hectare) Pingree Forest in Maine, which is being managed under a Forest Stewardship Council compliant monitoring scheme that provides annual check-ups and in-depth assessments at each five year interval.[25]

HOW MARKETS CAN HELP

In the coming years, we must—and we can—ensure that efforts to adapt to the impacts of climate change in North America are well thought out and are targeted at protecting both the public good and our green infrastructure. As an increasingly popular adage in the conservation community now goes, however, "Conservation without money is just conversation."

Fortunately, as is detailed in the growing body of literature on conservation finance, the inventive use of cap-and-trade markets and of similar markets such as wetlands mitigation markets, wildlife conservation banks, and nutrient-farming markets, can provide financial incentives and sorely needed capital for public, private, and non-profit organizations that provide conservation management services. [26]

To cite just one example, the Lieberman-Warner legislation considered by Congress in the late spring of 2008 came as close as any legislative effort in the U.S. Congress to date to create a cap-and-trade mechanism for limiting fossil fuel emissions into the atmosphere. The legislation included a provision that would have channeled substantial amounts of money from the proceeds of public credit auctions to adaptation efforts undertaken by the federal and state governments.[27] While the legislation did not pass during this session of Congress, the prospects for similar initiatives in the next several years are promising.

CONCLUSION

Although climate change will likely alter how conservationists strategize over implementing habitat conservation, it in no way diminishes the overall need for land conservation. But which land and water environments should we spend the time, effort, and capital to save, given that some lands are already being submerged,

and some lands are already experiencing severe drought, and some lands are already the target of voracious invasive species? Approaches to land and biodiversity conservation that appeared relatively straightforward and sensible in the context of a fairly stable climate generally now need re-examination. The conservation community needs to adopt strategies that will be robust over time, even as dynamic and sometimes wrenching change occurs.

Will moving the policy apparatus toward comprehensive action on observing, planning, acting, and monitoring adaptation to climate change be either easy or straightforward? Undoubtedly not. Has momentum begun to build toward a climate policy that recognizes the need to adapt the practice of conservation? It has indeed. Can the U.S. maintain its national priority on reducing greenhouse gas emissions at the same time that it implements realistic and effective adaptation policies? That is a tall order. Yet if the precedents set by Teddy Roosevelt in helping to save American forests in the 1900s, by Hugh Hammond Bennett in responding to the Dust Bowl in the 1930s, or by Rachel Carson in sounding the alarm for environmental protection in the 1960s and 1970s are any indication, the task is well within the capacity of the American people—and much preferable to the dismal alternatives.

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Endnotes

1. *Climate Change and the Poor* (2008).
2. Gore (1992, p. 240).

3. "Increase in Carbon Dioxide Emissions Accelerating" (2006).
4. This article focuses on the impacts of climate change on North American ecosystems (primarily in the United States and Canada). The impacts of climate change in many places in the developing world, such as Bangladesh and Indonesia, also pose dramatic challenges to human societies and ecosystems. For more on that topic, see *The Economist,* September 9, 2008, also cited. See also, Intergovernmental Panel on Climate Change, IPCC Fourth Assessment Report, Working Group II, Impacts, Adaptation and Vulnerability, available at http://www.ipcc.ch/ipccreports/ar4-wg2.htm .
5. "Sea Level Rise and Coastal Habitats of the Chesapeake Bay: A Summary" (2008).
6. Logan, Régnière, and Powell (2003, 130).
7. Emery (2008).
8. Nikiforuk (2007, pp. 68-76).
9. For a review of 866 of such articles, see Parmesan (2006, pp. 637-669).
10. SEG (2007, p. 82).
11. Levitt and Chester (2008).
12. For further information on discussions at the conference, Levitt and Chester (2008). For further reference on these and related topics, see the Conservation and Climate Change Clearinghouse, hosted by the Kendall Foundation at http://www.kendall.org/clearinghouse/.
13. Nijhaus (2007).
14. Backlund, Janetos, and Schimel (2008).
15. Parmesan and Yohe (2003, pp. 37-42).
16. See Logan and Powell (2001, pp. 160-172). See also Powell and Logan (2005, pp. 161-179).
17. Botkin et al. (2007, 10).
18. Two other notable forecasts on the effects of climate change on biodiversity are: Neilson et al (2005) and Thomas et al (2004).
19. "Save of the Week" (2007)
20. Y2YCI (2007).
21. Hansen (2007).
22. Chester (2006).
23. Wilson (2006).
24. See press releases and videos regarding the Blackfoot Challenge's Innovations in American Government Award at http://www.fws.gov/mountain-prairie/pfw/r6pfw18.htm.
25. Levitt (2006).
26. Levitt (2005). See also Clark (2006) and Ginn (2005).
27. Kosytack (2008).