

*Since the founding of the Republic, generation after generation of Americans has fallen in love with magnificent and, in several instances, seemingly magical communications and transportation networks that have brought us closer together and helped to transform the way we live, work, trade, learn, and play. But fervor subsides, and in the afterglow Americans have repeatedly come to understand that new networks also present the nation with substantial challenges, including the potential for dramatic disruptions to landscapes, ecosystems, and biodiversity. In this article, adapted from the book that he edited, Conservation in the Internet Age, James Levitt explores the historic and present-day threats and opportunities presented to the conservation community by such systems.*

# NETWORKS AND NATURE IN THE AMERICAN EXPERIENCE

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**T**he story of changing land use patterns, environmental disruption, and conservation across the United States and North America offers a rich diversity of themes: it is a complex story with many threads. It is a tale of conquest and of ongoing contests for political, economic, and social power among

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the many cultures present on the continent throughout history and in our own day.<sup>1</sup> It is a story that, since the time Columbus first set foot on Hispaniola, has been characterized by a dramatically growing population, spreading itself across the landscape in ever-evolving demographic configurations. Consider, for example, that the U.S. population grew from 3.9 million individuals in 1790 to some 280 million in 2000, and that this number is expected

to grow to some 400 million by 2050—a projected 100-fold growth over the span of 260 years.<sup>2</sup>

The story is also one of an amazing surge in affluence shared by many of the continent's citizens. Subsistence farmers barely hanging on to their homesteads in Kansas in the 1850s would be awed to walk into a modern supermarket sited on what was once their land, finding apples from New Zealand, water imported

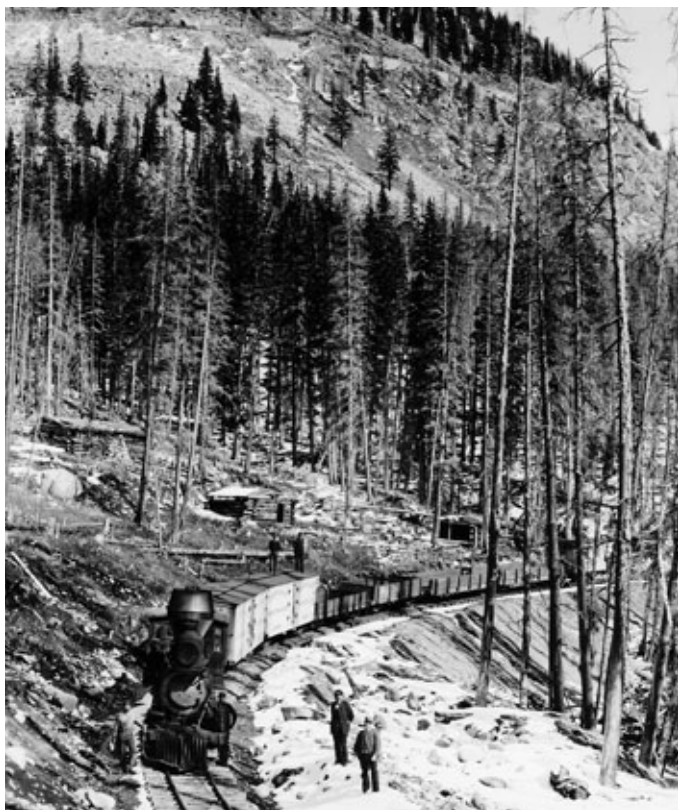
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**BY JAMES N. LEVITT**

from France, and sweatshirts manufactured in China wheeled out the door by thousands of locals living in nearby homes, each with indoor plumbing and plentiful heat. It is a story of rapidly advancing technology of numerous kinds, from Cyrus McCormick's mechanical reaper to Willis Carrier's air conditioner.<sup>3</sup> It is also a story of the ever more powerful and ubiquitous communications and transportation networks that have enabled the spread of people and structures across the land.

## THE SIGNIFICANCE OF NETWORKS IN AMERICAN CULTURE

Throughout history, Americans have attributed great significance to new transportation and communications networks and to the individuals who discover, build, and advocate for them. In the earliest days of the Republic, Thomas Jefferson, himself a network entrepreneur who sought to build roads, engineer canals, and launch ambitious expeditions to the West, actively sought information about the life of Christopher Columbus, an early icon of the adventurous American spirit.<sup>4</sup> Stories about Columbus's life and precedent-shattering explorations so impressed Jefferson and his compatriot George Washington that they named the District of Columbia in his honor.



COLORADO HISTORICAL SOCIETY

Historically, transportation and communication networks such as transcontinental railroads, interstate highways, telegraph grids, and telephone systems have affected where Americans live, work, and travel. In the process, these networks have contributed to both intended and unintended environmental impacts. This William Henry Jackson photograph of a Denver, South Park, and Pacific Railroad engine, taken near Alpine Station in Gunnison County, Colorado, in the 1880s, shows the machines and men that were instrumental to the transformation of the local landscape.

Enthusiasm for network pioneers, and for building new links to the West, continued unabated in the nineteenth century. Thomas Hart Benton, a powerful U.S. senator from Missouri, championed westward expansion and the idea of a transcontinental railroad throughout most of his long career. As an advocate of westward growth, he was greeted by attendees at the 1849 Pacific Railroad Convention in St. Louis with "rapturous applause." His oration was stirring:

*We live in extraordinary times...Mechanical genius has again triumphed over the obstacles of nature...the conveyance being invented which annihilates both time and space. Let us rise to the grandeur of the occasion. Let us complete the grand design of Columbus by putting Europe and Asia into communication, and that to our advantage, through the heart of our country. Let us give to his ships, converted into cars, a continued course unknown to all former times. Let us make the iron road, and make it from sea to sea...adorned with its crowning honor, a colossal statue of Columbus...pointing with outstretched arm to the western horizon, and saying to the flying passengers "There is the East, there is India."<sup>6</sup>*

U.S. President Bill Clinton, in a December 1999 speech on economic growth, revisited Benton's theme, emphasizing the importance of pathfinders and network entrepreneurs from both the private and the public sectors to our national identity:

*We know that our nation has always prospered when government has invested in giving people the opportunity to make the most of their vision and their dreams, from financing the Louisiana Purchase and the Lewis and Clark expedition to the interstate highway system and the space program....The American people have always been a bold and innovative bunch. We are always drawn to uncharted lands over the next horizon....That's what we do. Today, thanks to wise investments made by government and the private sector over many years, the American people have before them the unexplored continent of cyberspace and the prospect of discovering what is in the black holes in outer space.<sup>7</sup>*

Given our deep and historic ties to explorers, pioneers, and network entrepreneurs, it is no wonder that as a new set of actors again reduces barriers of time and space on our continent and throughout the world, we are ready and willing to lionize them and their achievements.

## NETWORKS AND ECONOMIC GROWTH

Our enthusiasm for new transportation and communications networks is grounded in economic common sense. We have long known that new pathways that reduce the cost and friction of doing business with the rest of the world are critical to the nation's wealth and prosperity. In 1803, Jefferson emphasized to Captain Meriwether Lewis the central importance of establishing new trade and communications routes as he launched Lewis and William Clark on their famous expedition: "The object of your mission is to explore the Missouri River...as, by its course and communication with the water of the Pacific ocean, may offer the most direct and practicable water communication across the

continent, for the purpose of commerce.”<sup>8</sup>

Commentators in our own day similarly have recognized the considerable impact of new networks. Michael Mandel, in the cover article on the “Internet Age” for the seventieth anniversary issue of *Business Week*, proclaimed that “the power to navigate the world at the click of a mouse is a force that is transforming our lives like none before.”<sup>9</sup>

An important benefit of new networks stems from what economists call network effects (or network externalities). Network effects are particularly well suited to democratic societies, as their benefits can spread so widely. On a publicly accessible network, new members gain access to each existing member, and existing members extend their reach to each new member; economic activity expands as the size of the entire pie gets bigger and as common resources can be pooled.

The citizens of Santa Cruz, California, expressed their genuine enthusiasm for such an effect when, in the 1870s, a new rail connection opened to their town. The local newspaper trumpeted: “At last our enterprising young city is in full connection with the rest of mankind.”<sup>10</sup> George Gilder expressed similar enthusiasm in the early days of the commercial Internet, referring to a dictum attributed to entrepreneur Bob Metcalfe: “Metcalfe’s law of the telecosm...[shows] the magic of interconnections: connect any number, ‘n,’ of machines...and you get ‘n’ squared potential value. Think of phones without networks or cars without roads. Conversely, imagine the benefits of

linking up tens of millions of computers and sense the exponential power of the telecosm.”<sup>11</sup>

Indeed, we have observed dramatic economic benefits associated with new networks repeatedly in our history. With the opening of the Erie Canal in 1830, the price of transporting a sack of grain from the Great Lakes to the Hudson River plummeted, encouraging the migration of farmers to the Midwest and helping catapult New York City past Philadelphia as the continent’s busiest port. Similarly, new telegraph networks were key to managing transcontinental rail systems, themselves engines of western growth following the American Civil War.<sup>12</sup> Sam Walton relied heavily on sites with highway intersections and in-house computer networks in building Wal-Mart, the largest private employer in the United States in 2000.<sup>13</sup> And, despite the recent decline in the market value of dot-com companies, a new generation of technologies, exemplified by the Internet, wireless telephone systems, and express delivery networks, continues to transform daily life in cities, suburbs, rural communities, and even the most remote wilderness areas in the United States and around the world, from Arkansas to Antarctica.

### OVEROPTIMISTIC SOCIAL FORECASTS

Unfortunately, although we are good at recognizing the power of new networks to help reshape economies, Americans have a history of excessive optimism regarding the ability of such net-



(FOREST HISTORY SOCIETY PHOTO COLLECTION.)

*The construction of the Erie Canal and eastern railroads disrupted the lives of New England farm communities that could no longer compete with more efficient agricultural producers from the Midwest. This Harvard Forest Diorama shows white pine invading abandoned Massachusetts farmland around 1850.*

works to solve a wide variety of social problems. In the 1880s, for instance, prominent commentators predicted that by allowing the leaders of the world's great nations to communicate instantaneously, the global telegraph network could help usher in an era of lasting peace. Henry Field spoke of the transoceanic cable as "a living, fleshy bond between the severed portions of the human family, along which pulses of human tenderness will run backward and forward forever. By such strong ties does it tend to bind the human race in unity, peace and concord."<sup>14</sup> Field offered that flawed insight prior to the outbreaks of World War I and World War II.

In a similar vein, Nicholas Negroponte, head of the MIT Media Lab, told an audience in Brussels in 1997 that "the Internet would do no less than bring world peace by breaking down national borders." Twenty years from now, he said, children who are used to finding out about other countries through the click of a mouse "are not going to know what nationalism is."<sup>15</sup> In light of subsequent nationalistic atrocities committed in Kosovo and the tragic destruction of the World Trade Center in New York, Negroponte's prognostications seem no more likely than Henry Field's.

Our tendency to make overoptimistic social forecasts extends to more mundane matters. In the late 1970s, Alvin Toffler confidently predicted that with the advent of advanced telecommunications, "paperless offices" would become common in corporate America. His comment caused real concern among paper manufacturers, but they need not have worried. Although the use of paper has shifted—we now send fewer first-class letters and use more paper for printers and packaging—world paper consumption tripled between the 1960s and the 1990s, and forecasts show global consumption growing another 50 percent by 2010.<sup>16</sup>

In the early and mid-1990s, sources ranging from the U.S. Department of Energy to AT&T excitedly predicted that telecommuting and e-commerce would make significant dents in per capita rates of automobile and truck travel as well as in associated energy consumption.<sup>17</sup> Analysts such as Patricia Mokhtarian at the University of California at Davis point to a quite different outcome. Mokhtarian's long-term study of California telecommuters shows that while some telecommuters may marginally reduce their own annual mileage logged in automobiles, any gains are likely to be swamped by long-term nationwide growth in annual per-person vehicle miles traveled. As Mokhtarian notes, "Historically, transportation and communication have been complements to each other, both increasing concurrently, rather than substitutes for one another. And we have no reason to expect that relationship to change."<sup>18</sup>

## MYOPIA REGARDING THE ENVIRONMENTAL EFFECTS OF NETWORKS

Just as we have a history of making overly optimistic social forecasts regarding new network technologies, we have failed to recognize and mitigate potentially disruptive environmental impacts associated with emerging communications and transportation systems. Two brief histories serve to illustrate.

In his landmark 1864 work *Man and Nature*, George Perkins Marsh, then Abraham Lincoln's ambassador to Italy, warned of many ways in which the "destructiveness of man" can disturb natural systems. Having served as Vermont's railroad commissioner, and being a vocal critic of railroad corporations, Marsh

was quite familiar with the changes associated with new transportation grids spreading across the land. In *Man and Nature*, he noted that:

*The modern increased facilities of transportation have brought distant markets within the reach of the professional hunter, and thereby given a new impulse to his destructive propensities. Not only do all Great Britain and Ireland contribute to the supply of game for the British capital, but the canvas-back duck of the Potomac, and even the prairie-hen from the basin of the Mississippi, may be found at the stalls of the London poulterer.... Reproduction, in cultivated countries, cannot keep pace with this excessive destruction, and there is no doubt that all the wild birds which are chased for their flesh or their plumage are diminishing with a rapidity which justifies the fear that the last of them will soon follow the dodo and the wingless awk.*



U.S. LIBRARY OF CONGRESS, BRADY-HANDY COLLECTION

George Perkins Marsh, pictured here by Civil War-era photographer Matthew Brady, was an early and prescient observer of the impact of transportation networks on wildlife populations.

Despite the literary success of Marsh's tome, Congress took little notice or action over the next decade to prevent such "excessive destruction." It took more than a decade after its creation in 1872 for Yellowstone National Park to be designated to serve as a sanctuary for the bison, which were also nearly extirpated by amateurs and professionals who made extensive use of western railroads to facilitate their hunt.<sup>20</sup> And not until 1903, nearly forty years after Marsh published his warning, did Theodore Roosevelt, with the encouragement of the rapidly growing Audubon movement, establish the first federal preserve for seriously endangered migratory birds on Pelican Island, Florida.

Marsh's observations highlight the negative flip side of seemingly magical network effects: when a new network offers substantial numbers of people fresh access to a relatively untapped natural resource, and those people can exploit that resource at little or no incremental cost, they can quickly degrade or destroy it. To use a phrase popularized by ecologist Garrett Hardin in 1968, low-cost access provided by new networks can enable a "tragedy of the commons."<sup>21</sup> In North America, birds, bison, forests, and soil, as well as clean water and fresh air, have all suffered at various points from such relatively unfettered access and unrestricted use.

A second case of shortsightedness regarding the environmental impact of new networks is related to President Eisenhower's bold proposal, during his first administration, to build a national system of interstate highways.<sup>22</sup> The term "environmental impact" is used advisedly; it did not come into common parlance until



Facilitated by a network of western railroads, the bison population was almost entirely wiped out in the 1870s by professional and amateur hunters. This photo shows an 1876 buffalo hide yard in Dodge City, Kansas, that claimed to include some 40,000 buffalo hides.

newly created state and federal environmental protection agencies began requiring developers to submit environmental impact statements in the 1960s and 1970s.<sup>23</sup>

The U.S. Senate's Subcommittee on Public Roads met in February and March 1954 to hear testimony regarding Eisenhower's initiative, which his advisor Francis du Pont had shaped into the proposed Federal-Aid Highway Act.<sup>24</sup> During Senate hearings that winter, one enthusiastic booster after another testified regarding the cost, engineering challenges, and potential benefits of the interstates and the related forest highway system. Senator Wayne Morse of Oregon argued that "the economic changes in our country in the last forty years have made interstate commerce now very much dependent upon a Federal highway system." Major General Paul Yount, chief of transportation for the U.S. Army, held that the proposed system was important "to serve the national defense." Officials responsible for managing the nation's natural resources, such as Edward Cliff, assistant chief of the U.S. Forest Service, emphasized that "the need for the improvement of the forest highway system is urgent," to provide a link from forest to mill as well as public access for recreation. In related testimony, Leo Bodine, executive vice president of the National Lumber Manufacturers Association, lobbied forcefully for expanded federal funding for "more timber access roads, [which] must be provided to open up old-growth timber stands and to salvage blowdown and insect-infested timber on national forests."<sup>25</sup>

The proposed interstate highway system was indeed a grand scheme replete with opportunities for the nation. But records of the Senate hearings reflect very little substantial concern with the system's possible environmental and conservation impacts. The strongest recorded statement appears in a letter from the

Pennsylvania Association of Township Supervisors endorsing a local "Don't Be a Litterbug" campaign.<sup>26</sup>

Not until the following year, in testimony before the U.S. House of Representatives, did Howard Zahniser, executive director of the Wilderness Society, sound a serious note of caution, urging Congress to adopt a policy whereby "no highways shall be constructed or planned...in or across any national park or national monument, any national wildlife refuge, or any duly designated wilderness, wild, primitive, or roadless area within the national forests."<sup>27</sup> During his testimony, Zahniser took pains to assure members of Congress that he was not opposed to road

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development; he simply wanted to ensure that certain natural areas would be preserved intact.

In retrospect, we can see the prescience of Zahniser's testimony. As he warned, high-speed roadways built in the last half of the twentieth century have been associated with disruptive effects on wilderness areas and wildlife habitat—including spotted owl habitat in old-growth forests that Leo Bodine wanted to

access for logging.<sup>28</sup> The new roadways are also associated with myriad other environmental effects, including urban, suburban, and rural sprawl; an increase in air pollution in many parts of the country; and the generation of carbon dioxide and other gases associated with global climate change—an issue not on the radar screens of Congress in the 1950s.

Zahniser was not the first to point out the potential threats of new highways, nor was he the last. The group that founded the Wilderness Society, including Bob Marshall, Aldo Leopold, and Benton MacKaye, had been trying to underscore the issue for decades, as eloquently pointed out by Paul Sutter in his recent book, *Driven Wild*.<sup>29</sup>

Despite Zahniser's foresight, neither the public nor Congress was noticeably moved, and President Eisenhower signed the Federal-Aid Highway Act of 1956 into law without any significant provisions regarding conservation or environmental protection. It was the publication of Rachel Carson's *Silent Spring* in 1962 that set off widespread public concern for wildlife and wilderness. The Wilderness Act did not become law until September 1964, four months after Zahniser's death, and not until six years later, with the 1970 Clean Air Act, did the United States institute the first national program to manage air quality.

The traditional myopia of Americans, as well as of observers from Europe and elsewhere, regarding the potentially disruptive environmental effects of new networks has extended into the Internet age. A number of popular books published in the late 1990s by prominent Internet enthusiasts that predicted bright

social futures in the twenty-first century generally ignored or gave short shrift to the potentially disruptive environmental effects of the current generation of new networks.<sup>30</sup> Environmentalists are prone to similar oversights: several recent high-level analyses of sprawl have focused on the already well-explored connection between the growing use of cars and highways and the loss of open space, disregarding the potential impact of newer networks.<sup>31</sup>

However, as unbridled enthusiasm for the Internet and related networks has substantially subsided, our myopia regarding the effect of the Internet and related networks on land use and biodiversity is due for correction. Evidence provided by early empirical research and a wealth of anecdotal information gives support to the idea that the Internet, express delivery systems, and associated networks appears to play an important role in the mix of technological development, growing affluence, and demographic change that is proving to be disruptive to our landscape and biodiversity in our own day. It appears that the new networks affect the shaping of settlement patterns and landscape usage patterns in at least two ways:

- Most directly, the Internet, express delivery systems, and related networks serve as key enablers of deconcentrating settlement and development patterns—commonly called sprawl—in North America.<sup>32</sup> By reducing the friction of distance, the new networks give individuals, households, and organizations greater mobility and locational flexibility, increasing people's ability to travel, live, and work where they like in urban, suburban, and nonmetropolitan areas, including those with relatively high levels of natural amenities. The new networks offer this growing mobility and locational flexibility in combination with existing infrastructure; they work cumulatively with railroad, highway, airport, telephone, and media networks already in place.
- Indirectly, the new networks stimulate greater mobility and locational flexibility by contributing to general economic expansion and growing levels of personal affluence. With more affluence, people have a greater ability to travel, to build bigger residences and workplaces, and to move to preferred locations that may have previously been unaffordable.

Americans have good reason to be concerned that new communications and transportation networks may unleash unexpected and disruptive forces on the landscape. However, these changes also bring considerable reason for hope. Indeed, over the course of American history, similar conditions have provided the context for landmark conservation initiatives that have made a lasting mark in the field of conservation and on the national atlas.

Examples of such innovations, very briefly described below, include the establishment of the world's first national park in Yellowstone in 1872, the creation of the world's first land regional land trust in the 1890s, and the conception of the Land and Water Conservation Fund in the 1950s and 1960s. While such historical precedents cannot, of course, guarantee that similar initiatives will occur again, they illustrate the type of achievement that may be possible in coming decades.

- In the early 1870s, in the midst of the completion of transcontinental railroad networks that had an enormous impact on shaping land-use patterns, entrepreneurs Jay Cooke and



(THE WILDERNESS SOCIETY)

Howard Zahniser, executive director of the Wilderness Society (1945–64), warned of the potentially disruptive consequences of interstate highways to wilderness in testimony before Congress in 1955.



Thomas Moran's painting of the Grand Canyon of the Yellowstone was an important part of the 1872 lobbying effort to create the world's first national park at Yellowstone. The painting was so well received that it was purchased by the federal government and displayed in the Senate lobby.

Frederick Billings of the Northern Pacific Railroad underwrote the successful lobbying effort to create the world's first national park at Yellowstone. Their sponsorship of the western travels of painter Thomas Moran proved to be particularly important. Moran's magnificent paintings of the Grand Canyon of the Yellowstone were key to efforts to impress upon eastern politicians the scenic grandeur of vast western landscapes.<sup>33</sup>

In pursuit of a mix of self-interest and the national interest (or, as historian Robin Winks expresses it, "commerce and conservation"<sup>34</sup>) Cooke and Billings helped to launch a method of land protection that has had an enormous impact around the world. A recent count by the International Union for the Conservation of Nature indicates that there are on the globe today some four billion square kilometers of land designated as national parks (as distinguished, for example, from national forests and other types of protected lands). That represents a land mass larger than the one covered by all of the fifteen current member nations of the European Union, including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.<sup>35</sup>

- In 1891, Charles Eliot, son of the president of Harvard, successfully made the argument for the establishment in Massachusetts of the world's first regional non-governmental land trust. He was greatly concerned with the "poisonous" conditions faced by the poor, increasingly concentrated in upward and outwardly growing metropolises—places enabled in their growth by burgeoning electric, telephone and subway networks.<sup>36</sup> By spearheading the effort to establish what is today known as The Trustees of

Reservations, Eliot helped found a land trust movement which today includes more than 1,200 similar organizations based in North America, Latin America, Europe, and the Pacific. Those groups, collectively, have in the last century conserved tens of millions of acres of farmland, forestland, recreational open space, and wilderness around the globe.<sup>37</sup>

- In the 1950s and 1960s, Laurence Rockefeller, an heir of John D. Rockefeller and a markedly successful aviation and venture capital investor in his own right, chaired the Outdoor Recreation Resources Review Commission and its successors for Presidents Eisenhower, Kennedy, and Johnson. The Commission, recognizing that the recreational demands of Americans were in part changing due to the advent of high-speed automotive travel, recommended the establishment of a Land and Water Conservation Fund (LWCF) to be financed from oil-related federal revenues—first from the Highway Trust Fund and later from off-shore oil lease payments. Although funding appropriated by Congress for the LWCF been very uneven in recent years, the fund has since its inception helped to finance more than 37,000 state and local projects.<sup>38</sup>

## THE CONSERVATION CHALLENGES OF THE TWENTY-FIRST CENTURY

During the same decade that interstate highway construction was reaching full throttle and the Land and Water Conservation Fund was launched with money from the Highway Trust Fund, a new generation of communications and transportation networks was being conceived. Similar to the interstate highways, the rationale

for building the Internet was in part military. The U.S. Department of Defense Advanced Research Projects Agency (DARPA) funded the first precursor to the Internet in the late 1960s. Scientists at Bolt Baranek & Newman (BBN) in Cambridge, Massachusetts, were awarded a contract to build a system that could connect researchers working at disparate locations. The BBN researchers employed packet switching technology to allow decentralized but interconnected computers to continue operating even if one of the nodes failed—a function critical to military and political leadership in the event of a conventional or nuclear attack on command facilities. The system, initially called ARPAnet, allowed researchers at UCLA, the University of California Santa Barbara, Stanford Research Institute, and the University of Utah to communicate by computer as early as fall 1969.<sup>39</sup> Growing from the humble ARPAnet beginnings, the public Internet mushroomed over subsequent decades and had attracted some 236 million active users around the globe by July 2001.<sup>40</sup>

During the same era that the Internet's precursor was being hatched, Fred Smith, an undergraduate at Yale, wrote a senior paper outlining his idea that companies with significant investments in information infrastructures would be well served by a rapid-delivery network that could provide expensive spare parts for computers on short notice. Although Smith's professor graded the paper a "C," after graduation and service as a Marine in Vietnam, Smith built upon his idea, launching a new business called Federal Express. The company, also known as FedEx, commenced operations in April 1973.<sup>41</sup> In 2001, FedEx had a physical presence in almost every major city of the world and ranked 112 on the Fortune 500 with revenues of \$19.6 billion.

In effect, less than forty years since they were conceived, these novel and still-evolving communications and transportation networks reach almost every center of commerce and exchange on earth. Given that the initial intent of network designers was to serve widely dispersed locations, it is not surprising, as noted by William Mitchell, that during the last decade of the twentieth century the networks appear to have enabled increasingly widely

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## In the 2000 elections, voters approved 84 percent of local and state proposals to acquire open space, committing nearly \$8 billion.

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dispersed demographic, economic, and land use patterns in North America. In the context of a general growth in U.S. population during the 1990s we have witnessed a positive net in-migration to rural areas, particularly those non-metropolitan areas with high levels of natural amenities; an accelerated rate of U.S. open space consumption; and new settlement patterns in environmentally sensitive locations such as the Greater Yellowstone ecosystem that appear to be closely associated with habitat disruption and severe pressures on wildlife populations.<sup>42</sup> If, as forecast, twenty-first century communications and transportation networks become even faster, cheaper, and more ubiquitous than they were at the close of the twentieth century, the accompany-

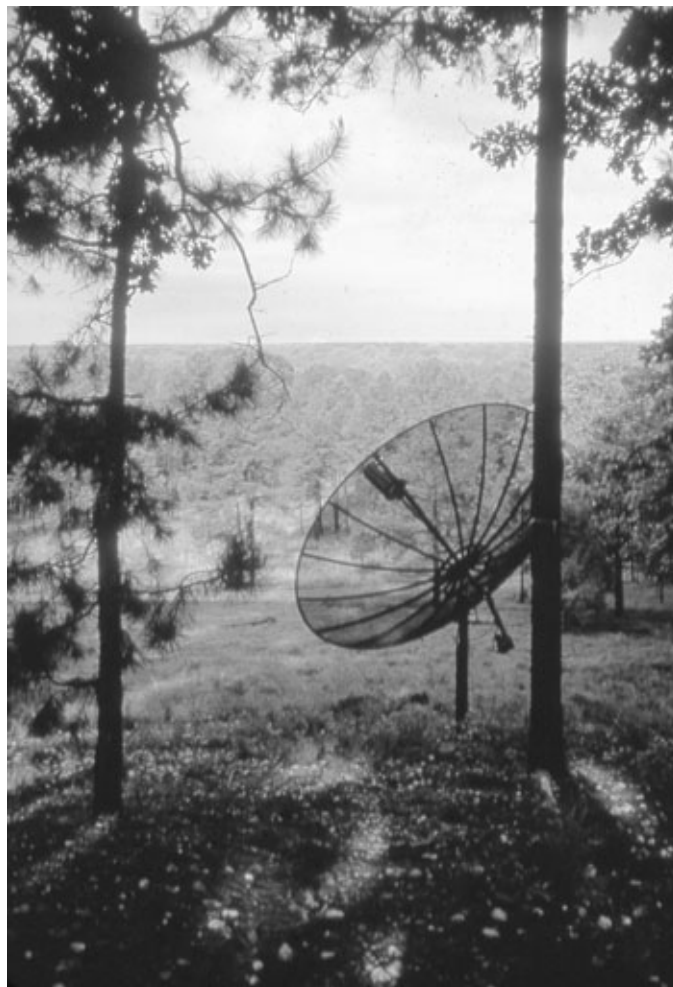


PHOTO BY STEVEN ANDERSON

*Similar to their historic counterparts, new networks in the twenty-first century are likely to continue to affect demographic and land-use patterns in North America. Rapidly spreading Internet and satellite communications systems appear to serve as enablers of exurban sprawl, complicating resource management challenges at the wild-land-urban interface.*

ing social changes may yield increasingly significant cumulative impacts on open space and biodiversity.

It is consistent with the American experience in earlier eras that, in the context of the present surge in technological, demographic, and land use change, there is also heightened public concern regarding land use and the environment. For example, in the 2000 elections, voters approved 84 percent of local and state proposals to acquire open space, committing nearly \$8 billion.<sup>43</sup> The total funds committed for such use from 1998 to 2000 exceeded \$20 billion.

Also consistent with historical precedent, land and biodiversity conservation initiatives have enjoyed the support of an impressive array of entrepreneurs and their families associated with the new communications and transportation networks. Ted Turner, the legendary cable entrepreneur, is also reportedly the largest private landowner in the United States. Turner and his family are committed to managing their land to preserve open space and wildlife habitat and strongly support environmental and land trust initiatives in the United States and abroad.

Similarly, Gordon Moore, a founder of Intel, is a remarkably



generous supporter of biodiversity initiatives, having dedicated a share of his Intel stock worth several billion dollars to a new foundation that will finance conservation, educational, and scientific initiatives.<sup>44</sup> Indeed, with the support of Turner, Moore, and likeminded philanthropists, as well as individuals and organizations spread throughout the public, non-profit, private, and research sectors in North America, a remarkable generation of conservation innovations are emerging in the fields of conservation science, conservation education, policy and advocacy, resource protection, and stewardship.<sup>45</sup>

Will the present generation realize a set of landmark conservation innovations that are commensurate with challenges faced in the early twenty-first century? Will these innovations equal the novelty, significance, effectiveness, replicability, and ability to endure<sup>46</sup> of the world's first national park, the first regional land trust, or the novel Land and Water Conservation Fund? It will be up to future generations of conservationists and historians to judge the success of current efforts.

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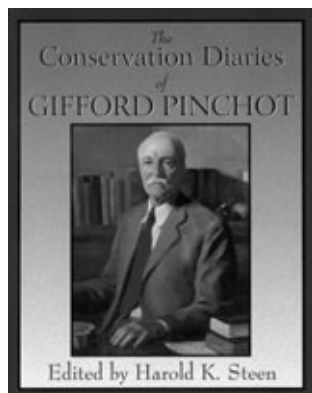
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## NOTES

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31. For example, Benfield, Raimi, and Chen's book *Once There Were Greenfields* (Washington, DC: Natural Resources Defense Council and the Surface Transportation Policy Project, 1999).
32. Both the Internet and express delivery networks such as FedEx are exemplary cases of emerging global communications and transportation networks; associated wired and wireless communications networks, ranging from cellular phone networks to self-organizing sensor networks, as well as increasingly sophisticated physical transportation and logistics networks, are included here by reference as "associated networks." The author has explored most extensively the potential impact of new networks on the landscape and biodiversity of North America.
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34. Robin Winks, *Frederick Billings* (New York and London: Oxford University Press, 1990): 274.
35. The fifteen nations of the European Union have a total area of 3,235,460 square kilometers, per the USDA's Economic Research Service ([www.ers.usda.gov/briefing/EuropeanUnion/basicinfo.htm](http://www.ers.usda.gov/briefing/EuropeanUnion/basicinfo.htm)); the four million square kilometers of national parks is about 1.2 times the size of the fifteen member nations of the European Union.
36. Gordon Abbott, *Saving Special Places* (Ipswich, MA: Ipswich Press, 1993): 6–10.
37. For information on the land trust movement, see the Land Trust Alliance web site at [www.lta.org](http://www.lta.org). Local and state land trusts had saved more than six million acres by 2000; similar national and international organizations, including Conservation International, The Nature Conservancy and the Trust for Public Land have helped to conserve many millions more acres.
38. For additional information on the Land and Water Conservation Fund, see [www.ncrc.nps.gov/programs/lwcf](http://www.ncrc.nps.gov/programs/lwcf).
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42. See the contributions by William Mitchell, Kenneth Johnson, Ralph Grossi, John Pitkin, Andrew Hansen and Jay Rotella in James N. Levitt, editor, *Conservation in the Internet Age: Threats and Opportunities* (Washington, DC: Island Press, 2002).
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44. "The 400 Richest People in America, 2001 Edition," *Forbes* (September 2001): 142.
45. See the contributions by Leonard Krishtalka, John Fitzpatrick, Jacob Scherr, William Roper, Bob Durand, Sharon McGregor, Joel Hirschhorn and Peter Stein in Levitt, *Conservation in the Internet Age: Threats and Opportunities*.
46. For a discussion of criteria used to assess landmark conservation innovations, see James N. Levitt, "Conservation Innovation in America: Past, Present, and Future," *Occasional Papers Series* (Cambridge, Massachusetts: Institute for Government Innovations, Kennedy School of Government, Harvard University, 2003).

## Conservation Diaries of Gifford Pinchot, edited by Harold K. Steen



The Conservation Diaries of Gifford Pinchot  
 Edited by Harold K. Steen  
 250 pages, illustrations, index  
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