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BIG ROADS, BIG RIGHTS: VARIETIES OF PUBLIC INFRASTRUCTURE AND THEIR IMPACT ON ENVIRONMENTAL RESOURCES

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Two types of public infrastructure—roads and property rights—are often thought critical to economic development; this Article compares their impacts on the natural environment. Both roads and property rights draw unfamiliar persons to remote areas, undermine existing informal resource practices, and enhance wide commercial trade, creating wealth but also reducing local resource diversity. New kinds of property rights hold much promise for environmental protection, but unlike roads and conventional property rights, environmental property rights would be tasked with curtailing commerce, as in roadless areas and caps on resource use. This sharp divergence from the traditional commercial mission of public infrastructure can limit support for environmental property rights, creating an opening for fuzzier and more consultative versions of environmental property.

INTRODUCTION

What is the relationship of property rights regimes to environmental goods? If one takes seriously the idea that property entails at least some ability to exclude, then environmental resources would seem to be those most likely to escape property regimes altogether. Who could exclude another from using the air, taking wild animals, sailing on the ocean? Those environmental resources that seem most pristine are often those most remote from property, at the depths of the sea or the heights of the mountains or the heart of the forest. To be sure, there have been private property regimes governing some aspects of these activities—English

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aristocrats' wildlife ownership, for example.¹ But the very resistance of environmental goods to "propertization" is one reason for their undoing. Since all too often, no one controls depredations on environmental resources, and since no one in particular can claim the benefits of investment in these resources, they are particularly subject to overuse and underinvestment, sometimes to the point of irrevocable collapse, as with the now-extinct passenger pigeon or old-growth forests of Europe and eastern North America.

With the advent of modern environmental law, the modern regulatory state has adopted the role of owner of environmental goods, determining their total allowable use through detailed regulation. But in the last two decades, regulatory thinking has increasingly turned to systems of private property rights in order to remedy environmental depredations. Among these are conservation easements for land and instream rights for water, but the greatest excitement has been reserved for the so-called cap-and-trade programs. The best known example is the United States' Acid Rain program, which capped the total sulfur dioxide ("SO₂") loading in the atmosphere and divided the allowable total into individual allowances that can trade in markets.² Tradeable rights regimes have also been successful with certain fish species in Australia and New Zealand,³ but much of today's talk about cap-and-trade revolves around climate change.⁴ Cap-and-trade systems, it is hoped, can help to prevent further loading of greenhouse gases into the atmosphere, without breaking the back of industrial development.⁵

Cap-and-trade thus entails one of the newest steps in the development of what I will call the "public infrastructure of property." Property rights regimes at a minimum require some system to define rights, to signal their presence, to monitor transgressions, to resolve disputes about who has what rights, and to enforce the rights held valid. Ancient communal irrigation systems, modern landed property, intellectual property, and now cap-and-trade allowances—all these varied property regimes share these minimal requirements. In this paper, however, I am particularly interested in what I call formal or "modernist" property rights—those that include the added elements of publicness in information and enforcement as well as alienability to any potential buyers, be they insiders or strangers in any

1. Dean Lueck, *Property Rights and the Economic Logic of Wildlife Institutions*, 35 NAT. RESOURCES J. 625, 630–34 (1995).

2. Clean Air Act, 42 U.S.C. §§ 7651–7651o (2000).

3. Robert T. Deacon et al., *Improving Efficiency by Assigning Harvest Rights to Fishery Cooperatives: Evidence From the Chignik Salmon Co-op*, 50 ARIZ. L. REV. 479, 484 (2008), and sources cited therein; Carrie A. Tipton, *Protecting Tomorrow's Harvest: Developing a National System of Individual Transferable Quotas to Conserve Ocean Resources*, 14 VA. ENVTL. L.J. 381, 400–02 (1995).

4. See, e.g., Patricia Ware, *International Coalition Formed in Lisbon to Establish Cap-and-Trade Carbon Market*, 30 INT'L ENVTL. REP. 874 (2007) (describing plans of several U.S. states, Canadian provinces, and European countries to lower greenhouse gases through carbon trading market).

5. See, e.g., Victor B. Flatt, *Taking the Legislative Temperature: Which Federal Climate Change Proposal is "Best"?*, 102 NW. U. L. REV. 123, 137 (2008) (describing current climate change proposals and prevalence of cap-and-trade as method).

given community. These are the kinds of property rights that modern property theorists as well as traditionalists refer to as “*in rem*”—good against “the world.”⁶

This Article views modernist property rights through what might seem a peculiar lens: it compares the environmental implications of modernist property rights to those of another kind of public infrastructure, namely roads. The environmental impacts of roads and property rights, of course, are not necessarily or even predominantly independent phenomena. Indeed, roads and modernist rights tend to occur in sequence. As roads open up previously undisturbed ecological resources to new kinds of commercial development, they bring new entrants who exploit those resources or convert them to new uses.⁷ The arrival of new players, however, may overwhelm any preexisting property regimes, leaving seemingly “free” resources open to a kind of free-for-all, along with attendant social conflict, dissipation of rents, relentless searches for the quick buck, and, of course, environmental degradation.⁸ But at a somewhat later stage, new settlers may also come to demand the very kinds of modernist property rights—formal rights in land, commodities, and financial instruments, for example—that dampen down conflicts, encourage long-term investment, and enhance far-flung commerce.⁹

In the gap between roads and rights, environmental destruction is easily understood under the rubric of the well-known “tragedy of the commons.”¹⁰ Much of this Article, however, focuses on the more stable and generally somewhat later scenario, if and when secure and well-understood property rights succeed in containing social conflict and encouraging wealth-creating investment and trade. There are unquestionably environmentally beneficial effects of this evolution in property rights. The argument of this Article, however, is that modernist property regimes, too, are very likely to have some distinctive and adverse impacts on environmental resources, creating a second gap, this time between the establishment of property rights and the establishment of environmental protection. The most notable aspect of this gap is the shrinking of ecological diversity—a feature that “big rights” share with “big roads.” Both these forms of public infrastructure encourage wide-ranging commerce, and their very bigness undermines the finer grains of local diversity.

6. See Thomas W. Merrill & Henry E. Smith, *The Property/Contract Interface*, 101 COLUM. L. REV. 773, 776–77, 789 (2001) (distinguishing contract from property rights in that the latter are good against “the world”).

7. See, e.g., Phillip M. Fearnside, *Avanca Brasil: Environmental and Social Consequences of Brazil’s Planned Infrastructure in Amazonia*, 30 ENVTL. MGMT. 735, 737 (2002) (describing usual path of roads followed by deforestation).

8. See LEE J. ALSTON, GARY D. LIBECAP & BERNARDO MUELLER, TITLES, CONFLICT AND LAND USE: THE DEVELOPMENT OF PROPERTY RIGHTS AND LAND REFORM ON THE BRAZILIAN AMAZON FRONTIER 15 (1999) (noting that arrival of new entrants on frontier may lead to breakdown of earlier resource regimes).

9. *Id.* at 15–16.

10. This phrase was coined by Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968) (arguing that resources open to use by all deteriorate from overuse and underinvestment).

If these forms of public infrastructure—roads and modernist property rights—foster commerce while diminishing environmental diversity, they nevertheless put some important items in the plus column for conservation. Commerce and trade tend to make societies wealthier, and economists argue that over time, wealthier societies tend to put a higher percentage of the national wealth into environmental protection.¹¹ Moreover, standard economic analysis would suggest that, perhaps ironically, roads and rights, by increasing commercial activities, also increase the value of ecological diversity simply by making diversity scarcer.¹² In that sense, roads and rights help to establish the preconditions for heightened environmental protection.

How, then, might an emergent higher valuation on environmental goods be satisfied in a society that has newly disposable wealth to satisfy that value? One type of answer is essentially reactionary: blow up the roads and ban property and commerce. This move undoubtedly has some appeal to environmental fringe groups,¹³ but even if efforts of this sort were to succeed, their resort to violence would cast doubt on any claim to moral superiority. Another option is intense “command and control” regulation, which has had substantial success in some areas; but the expense and rigidity of this kind of regulation has put it out of favor, at least for the moment.¹⁴ Moreover, the ascendance of global issues like climate change has made command-and-control seem irrelevant, at least on a worldwide basis, where there is no political basis for a uniform and intense regulatory structure.

Perhaps it is for those reasons that much of the discussion about environmental protection has turned to modernist property rights—that is to say, to increasing reliance on one of the very types of public infrastructures that have created the need for environmentally protective measures in the first place. As one moves from roads to modernist property rights, however, and then further still to the more specialized environmental property rights, one frequently finds some

11. See, e.g., Daniel C. Esty, *Bridging the Trade-Environment Divide*, 15 J. ECON PERSP. 113, 115, 119 (2001) (describing “Kuznets curve” of worsening followed by improving environmental protection over course of development); cf. Douglas A. Kysar, *Some Realism About Environmental Skepticism: The Implications of Bjorn Lomborg’s The Skeptical Environmentalist for Environmental Law and Policy*, 30 ECOLOGY L.Q. 223, 249–52 (2003) (accepting but criticizing major aspects of thesis that greater wealth leads to greater environmental protection).

12. Gary D. Libecap, *Open-Access Losses and Delay in the Assignment of Property Rights*, 50 ARIZ. L. REV. 379, 384 (2007) (noting that resources may grow more valuable due to depletion).

13. For a description of “ecoterrorism” (also distinguishing ecoterrorism from other forms of terrorism), see Chrystal Mancuso Smith, Comment, *From Monkeywrenching to Mass Destruction: Eco-Sabotage and the American West*, 26 J. LAND RESOURCES & ENVTL. L. 319, 322–25 (2006).

14. See Carol M. Rose, *Environmental Law Grows Up (More or Less), and What Science Can Do to Help*, 9 LEWIS & CLARK L. REV. 273, 279–82 (2005) (describing successes but noting emerging criticisms of command-and-control or “behavior-based” environmental regulation); cf. Wendy E. Wagner, *The Triumph of Technology-Based Standards*, 2000 U. ILL. L. REV. 83 (2000) (defending technology-based command-and-control environmental regulation).

striking similarities but also some distinct social and institutional differences. Roads, modernist property regimes, and environmental property regimes all have public-good characteristics, in the sense that under normal circumstances, no private actors can fully capture the gains from their establishment and maintenance.¹⁵ Public goods are always difficult to establish and manage, but they become increasingly problematic as one moves from roads to conventional modernist property rights and then to environmental property rights. Roads require a substantial effort, but they also have powerful supporters and constituencies.¹⁶ Modernist individual property rights systems have important constituencies, too, but they face more competition from those who favor preexisting or other informal rights regimes, and, in addition, they entail an ongoing governmental commitment to recordkeeping and enforcement rather than a relatively simple construction project followed by occasional repair. When one comes to *environmental* property rights systems, rights definition and enforcement take on even more complexity; one finds supporters for these efforts as well, but that support is relatively fragmented and unsteady—and beset by practical difficulties as well as skeptics and objectors.¹⁷

One problem for environmental property rights, then, is that the sequencing of public goods provision is very likely to put them late in the game, long after roads and somewhat after conventional property rights as well, and by that time considerable environmental damage may have already occurred. But there is another source of difficulty, too: environmental property self-consciously reverses the traditional commercial course of public infrastructure both of roads and of conventional property rights. Today's environmental laws consciously block off some environmental resources, turning them literally into roadless areas, precisely to halt the impacts that roads have on delicate resources and the people who depend on them.¹⁸ This feature, however, runs contrary to the traditional mission of roadbuilders and land sale offices, and it certainly generates conflicts

15. See, e.g., Jay B. Keshen & Rajiv C. Shaw, *Deconstructing Code*, 6 YALE J. LAW & TECH. 277, 378–80 (2004) (listing property rights regimes and highways among the classic examples of public goods).

16. See, e.g., Fearnside, *supra* note 7, at 738, 744 (describing support for roads in Amazon by Brazilian officials, investors, agribusiness interests).

17. See Thomas W. Merrill, *Explaining Market Mechanisms*, U. ILL. L. REV. 275, 290–97 (2000) (exploring various reasons for slow development of environmental market mechanisms).

18. For a survey of the efforts to preserve roadless areas in the United States, see Federico Cheever, *Not Quite Wilderness: The Development of Roadless Area Protection on Forest Service and BLM Lands* (University of Denver Sturm College of Law Legal Research Paper Series, Working Paper No. 07-37, 2007), available at http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=723149. A number of Latin American countries have created forest reserves for indigenous peoples, though there are many complaints that they are insufficiently enforced. See, e.g., Jo M. Pasqualucci, *The Evolution of International Indigenous Rights in the Inter-American Human Rights System*, 6 HUM. RTS. L. REV. 281, 315–19 (2006) (describing complaints against various Latin American countries for insufficient protection of indigenous lands against encroachers).

among those who want greater access to the now-blocked resources.¹⁹ Similarly, new forms of tradable environmental entitlements also use a blocking-off technique, although that aspect has not been much stressed in the legal literature: this is the “cap” in cap-and-trade, the portion of the resource not subject to use or trade or to the property-like tradable entitlements. These blocking features of environmental property rights render them even more difficult to establish and sustain than conventional property, for reasons that Gary Libecap describes: a cap on an environmental resource brings only uncertain payoffs, and those payoffs may be unevenly distributed, while the whole notion of a cap is opposed by those who can benefit from leaving the resource open.²⁰

These ascending difficulties for environmental property rights may explain why some environmentalists have in effect borrowed from a more old-fashioned and informal kind of property infrastructure—a property infrastructure that is fine-grained but “sticky” or “fuzzy.” Some contemporary environmental laws run counter to the modernist, simplifying trend of property rights definitions and instead turn environmental property rights into the fuzzy entitlements more characteristic of informal and small scale, community-based property regimes—that is, rights to be part of a process of consultation.

In Part I, this Article presents a series of issues about roads. Do they in fact depend on public efforts? The answer, to anticipate, is yes and no, but mostly yes. Next, how and why do roads have such dramatic impacts on the surrounding environment? Some reasons are easy to deduce—actual physical construction, for example, as well as the influx of new people that roads bring. But other reasons are subtler, particularly the role that roads play both in degrading local institutional constraints on resource use and in fostering wider commercial development with an attendant drift toward regional monocultures.

Part II then turns to the conventional modernist property regimes that often follow roads, finding some differences but also several very important features shared with the roads that so often precede them. Formal rights too can degrade preexisting resource management regimes without supplanting them, leading to considerable instability and environmental destruction. But even when formal rights are successfully implanted, their most notable shared features with roads are their joint drive toward expanded commerce and the drive of commerce itself toward environmental monocultures.

Part III examines the efforts to deploy modernist property rights for environmental purposes. This Part tracks the manner in which environmental property rights in some ways match up with, but in some ways sharply diverge from conventional modernist property rights—both in the goals of the enterprises,

19. See, e.g., John H. Cushman, Jr., *In the Utah Wilderness, A Question of Definition*, N.Y. TIMES, Jan. 28, 1997, at A12 (describing Utah counties’ resistance to federal and environmentalists’ efforts to declare certain areas roadless); James Langman, *Bolivian Settlers Push for Parkland Acreage*, ECOAMERICAS, Sept. 2007, at 4 (noting settlers’ protests to gain greater access to Madidi National Park for farming, logging, and ranching).

20. Libecap, *supra* note 12, at 405–08 (describing reasons for lag in controlling greenhouse gases).

and in the difficulties that environmental property rights regimes face. This Part then briefly takes up alternative types of environmental protection, particularly consultative regulatory forms, comparing these to the sticky or fuzzy property rights more characteristic of informal, small-scale, bottom-up property rights regimes.

The Article concludes with a note of caution: that in a global economy, we will be hard put to move forward environmentally without enlisting modernist property ideas, but that we should not be surprised to find that modernist rights regimes generate an environmentalist reaction in favor of sticky, fine-grained deliberations about entitlements. We should not be surprised by this outcome because environmental property rights in the end serve goals that are in many ways diametrically opposed to the normal commercial purposes that dominate roads and modernist property rights. The quest for alternative approaches is in itself a signal that environmental issues pose significant challenges for modernist property rights regimes.

I. BIG ROADS

A. Bottom up and top down

Is it really the case that roads and rights require a public infrastructure? Are there not “bottom up” roadways, as well as “bottom up” rights regimes—that is, roads and rights that do not depend at all on formal government and law, but rather on the initiative of individuals or groups acting on their own? The answer is, “yes, but . . .”

Some of the storied and romantic roads of the past are quite obvious examples of bottom-up roads. The Silk Road between medieval Europe and Asia is an example, as is our own Oregon Trail.²¹ Traders and travelers have long found routes to desired locations, and more traders and travelers have followed, if not directly in the pathways of the first, then at least more or less in the same locations. Even more easily traversed than overland routes are waterways, which have long been called “highways,”²² just as routes across the open seas are known as “roads.”²³ It was not government or law that created these bottom-up roads, but rather people acting on their own, what one might call the “unorganized public.”²⁴

21. For a brief history and description of the Silk Road(s), see Oliver Wild, *The Silk Road* (1992), available at <http://www.ess.uci.edu/~oliver/silk.html>. For a similar quick overview of the Oregon Trail and its travelers, see All About the Oregon Trail, <http://www.isu.edu/~trinmich/Allabout.html> (last visited Apr. 20, 2008).

22. See, e.g., *The Daniel Ball*, 77 U.S. 557, 563 (1870) (noting admiralty definition of navigable waters as those capable of use “as highways for commerce”).

23. This language is encapsulated in the “rules of the road” for appropriate conduct of vessels at sea. See, e.g., Rick Rambo, *Admiralty Law*, 31 TEX. TECH L. REV. 313, 320 (2000) (describing liability for collision at sea as depending on the statutory and customary rules of the road).

24. At least that is what I have called this kind of public. Carol M. Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711, 720–21 (1986) (distinguishing unorganized public from government). Others seem to find the idea useful as well. See, e.g., Karl P. Baker & Dwight H. Merriam,

Nevertheless, these bottom-up routes have obvious limitations. They are difficult and dangerous because they are largely unimproved and unpoliced. Their difficulties and dangers deter widespread or frequent use; these roads (the Oregon Trail, for example) have often attracted users who basically travel them only one-way, once in a lifetime. In turn, sporadic use generally means that bottom-up roads have a limited impact on the communities at either end. Marco Polo, for example, took only one round trip to China.²⁵ The cultural impact of his outbound trip on his Chinese hosts was necessarily curtailed when his two clerical companions took fright and abandoned the enterprise in the eastern Mediterranean; and while his trip home brought him personal riches and much encouraged Venetian trade and cultural exchange with the East, that trade concentrated on high-value luxury goods, a rather limited notion of commerce.²⁶ Those were very important exchanges over the course of centuries, but they pale when compared with the speed, volume, and variety of trade that flows across top-down roads.²⁷

Bottom-up roads often do play an important role in top-down overland roadbuilding. Top-down roads (in which I include canals and railroads) are likely to follow the paths set out by bottom-up ones: smoothing, paving, and policing the roads that the unorganized public has already created. Interstate 80 runs west through the Sierras roughly following the route that newcomers to California took on their own well over a century ago, passing near the location where the Donner Party met its demise.²⁸ On the other hand, some top-down roads may run through areas that were previously more or less untraveled, like Alaska's Dalton Highway,

Indelible Public Interests in Property: The Public Trust and the Public Forum, 32 B.C. ENVTL. AFF. L. REV. 275 (2005) (using concept of “unorganized public” as constraint on regulatory decisions about public land).

25. JOHN LARNER, MARCO POLO AND THE DISCOVERY OF THE WORLD 39–45 (1999).

26. William Dalrymple, *The Venetian Treasure Hunt*, N.Y. REV. BOOKS, July 19, 2007, at 29; see also DEBORAH HOWARD, VENICE AND THE EAST: THE IMPACT OF THE ISLAMIC WORLD ON VENETIAN ARCHITECTURE 1100–1500, at 116–17 (2000) (describing medieval traveler’s comment that Venetian warehouses were filled with merchandise, naming as examples high value goods: “spices, rare cloths, silk draperies”). For the impact of a modern road, see Amy Waldman, *Building a Superhighway Mile By Mile, India Paves a Smoother Road to Its Future*, N.Y. TIMES, Dec. 3, 2005, at A11 (describing changes in wake of partially-completed highway).

27. According to the national Bureau of Transportation Statistics, the vehicle miles traveled through rural areas alone on the Interstate system in 2004 was 266,996 million miles. See Bureau of Transportation Statistics, *Table 1-33: Roadway Vehicle-Miles Traveled (VMT) and VMT per Lane-Mile by Functional Class*, available at http://www.bts.gov/publications/national_transportation_statistics/html/table_01_33.html (last visited Mar. 7, 2008).

28. The Donner Party’s fateful winter camp was in the vicinity of Truckee, California, now on Interstate 80. For maps of their route, including a map of the location today showing Interstate 80, see Maps of the Donner Party, in Daniel M. Rosen, *The Donner Party*, <http://www.donnerpartydiary.com/maps.htm> (last visited Mar. 7, 2008).

built to service the Alaska Pipeline and stretching from just north of Fairbanks to Prudhoe Bay in the Arctic.²⁹

Whether they follow old routes or blaze new ones, top-down roads are likely to serve vastly more travelers than the intrepid adventurers who wend their way along the bottom-up roads. Transportation infrastructure is such a quintessentially public function that for millennia, roads and waterways have been at the core of western legal conceptions of public property.³⁰ In our own law, roadways have been the central example of the legitimate use of the power of eminent domain, and eminent domain for roads is approved even by those who vehemently disapprove of eminent domain for other kinds of economic development.³¹

Why have roads been so important to governments? For the Romans, a major reason for roads was military—control of an expanding empire.³² Military reasoning continues in our own major road construction; the interstate system was originally billed the National System of Interstate and Defense Highways.³³ But for the Romans somewhat,³⁴ and much more for modern governments, the overwhelming function of roads (as well as navigable waterways) has been to promote commerce.³⁵ Roads bring distant communities into contact with one another. Roads allow the exchange of ideas, sights, and above all, goods and services. In a word, roads expand markets, and all other things being equal, bigger markets are better for the economy. Bigger markets allow specialization and gains from trade, and they make property more valuable because it can be turned to more specialized uses and traded for a greater range of goods.³⁶

Because roads enhance commerce and wealth, governments often either build them themselves or subsidize privately-developed roads, as the United States government subsidized canals and railways with checkerboard land grants.³⁷ The

29. See Michael Finkel, *Journey to the Top of the Earth*, N.Y. TIMES, Aug. 18, 1996, at 17 (describing solitary drive along Dalton Highway to Alaskan northern coast).

30. Rose, *supra* note 24, at 723–30 (describing strong traditional doctrines of publicness of roads and waterways).

31. See, e.g., *Kelo v. City of New London*, 545 U.S. 469, 506, 512 (2005) (Thomas, J., dissenting) (describing roads along with canals, railroads, ferries and parks as “quintessentially public goods” for purposes of eminent domain, unlike the economic development project at issue in the case).

32. T. W. POTTER, ROMAN ITALY 127, 131 (1987) (describing military motivations in Roman roadbuilding).

33. See Paul Stephen Dempsey, *Transportation: A Legal History*, 30 TRANSP. L.J. 235, 314 (2003) (describing interstate system name, Eisenhower Administration’s interest in defense aspects of highways).

34. POTTER, *supra* note 32, at 130 (noting that one Roman road, the Via Salaria, was named for the salt trade).

35. Rose, *supra* note 24, at 744; see also Carol M. Rose, *Romans, Roads, and Romantic Creators: Traditions of Public Property in the Information Age*, 66 LAW & CONTEMP. PROB. 89, 97 (2003).

36. Rose, *supra* note 24, at 774.

37. Dempsey, *supra* note 33, at 248–50 (describing land grants to railroads); Nels Ackerson, *Right of Way Rights, Wrongs, and Remedies: Status Report, Emerging Issues, and Opportunities*, 8 DRAKE J. AGRIC. L. 177, 182 (2003) (noting earlier

expectation was that these transportation lanes would attract people to previously unsettled areas, raising the value of the land and repaying the cost of the roads themselves.³⁸ Not surprisingly, roadbuilding has important and powerful constituencies. Not only do many political officials want roads for military purposes³⁹ and economic development, but residents, settlers, and would-be developers of remote areas all press for roads that open up access and add to economic potential.⁴⁰

Notice that roads are *not* the products of small governments. Your village may have streets, mews, and alleys, but *roads* are the creatures of bigger public bodies: counties, states, nations—or empires, as with the Roman roads or with the sea lanes called “roads” that Britain’s navy once policed. Streets and alleys are cozy and familiar, but roads are decidedly different.

Because of their public goods characteristics and their expense, major roads are unlikely to be built by private actors, though there are exceptions when the private payoffs are great enough, as in the roads to oilfields in Alaska or Ecuador.⁴¹ But in the usual case, roads are built by governments, and those governments must have the capacity to undertake such a major capital investment—stability, access to capital and expertise, and a reasonably transparent administrative structure.⁴² Like their builders, roads are ambitious, cosmopolitan,

checkerboard grants to canals); *see also* PAUL GATES, HISTORY OF PUBLIC LAND LAW 341–56 (1968) (describing precedent for railroad checkerboard grants in road and canal grants).

38. Dempsey, *supra* note 33, at 249–50 (describing finances, expectations of higher value for both railroad lands and government-retained land).

39. *Id.* at 314 (describing how impressed Eisenhower was with the military uses of the German Autobahn system).

40. See, e.g., Fearnside, *supra* note 7, at 738, 744 (describing investor and landowner support for Amazonian roads); James Brooke, *Nalaikh Journal: Mongols Go From Camels to Jeeps and a Superhighway*, N.Y. TIMES, July 15, 2004, at A4 (describing official and popular support for new highway, enthusiasm for development potential); Juan Forero, *Demonstrations Cut Oil Output From Ecuador*, N.Y. TIMES, Aug. 20, 2005, at A6 (describing protests demanding road funds in Ecuadorian interior).

41. Both roads have been extremely controversial for their environmental effects. See, e.g., Comment, *Evolving Judicial Standards Under the National Environmental Policy Act and the Challenge of the Alaska Pipeline*, 81 YALE L.J. 1592, 1609–13 (1972) (describing early NEPA suit against Alaska pipeline and haul road permit); Judith Kimerling, *Disregarding Environmental Law: Petroleum Development in Protected Natural Areas and Indigenous Homelands in the Ecuadorian Amazon*, 14 HASTINGS INT’L & COMP. L. REV. 849, 849 (1991) (noting that oil company roads have opened large areas in Ecuadorian Amazon to settlers). Some California cities have experimented with private toll lanes to ease traffic congestion. See, e.g., Lathrop B. Nelson, Comment, *Unclogging Virginia’s Roads: Aligning Commuter Incentives in Northern Virginia*, 28 TRANSP. L.J. 185, 222–23 (2000) (describing San Diego and Orange County experiments); *see also* Lior Jacob Strahilevitz, *How Changes in Property Regimes Influence Social Norms: Commodifying California’s Carpool Lanes*, 75 IND. L.J. 1231, 1251 (2000) (describing effect of toll charge on commuter acceptance).

42. Cf. Waldman, *supra* note 26 (noting that India’s new superhighway has been impeded by local officials seeking bribes).

imperial, and often indifferent to their own impact on local conditions.⁴³ They are among the most important physical engines of globalization, or as much globalization as any particular government is capable of delivering.

Globalization, of course, opens local niche markets to competition. Shopkeepers may find themselves outcompeted by better-stocked stores in neighboring towns, or patrons may find that their former servants have gone off to exercise newly-found talents in other places. What happened to the itinerant knife-sharpener? The milkman? By opening up markets, roads have contributed to the demise of those niches as well as customer reliance on them. For some of the same reasons, roads have had a substantial impact on environmental niches as well.

B. Roads and the environment

Bottom-up roads, crude though they may be, certainly can have serious environmental impacts. Wagon marks are still visible today on old trails that once carried settlers across the United States. Those very trails deposited substantial numbers of people on the West Coast, and the new arrivals had major impacts on the environment as they fanned out into the countryside or settled in ever-expanding towns and cities. The discovery of valuable resource lodes can induce people to find their own routes to the sites of hoped-for instant riches, and once on the scene, these small-scale miners are perfectly willing to trash the environment, as in the foothills of California in the mid-nineteenth century or the gold areas of the Amazon today.⁴⁴ Moreover, informal roads like these are undoubtedly less amenable to monitoring and regulation than are larger public roads.

But formal top-down roads have an even more striking impact on the environment than bottom-up ones. The first kind of environmental impact of roads is simply the physical change wrought by a road itself. Roads in forested areas obviously necessitate felling trees and often the disposal of construction detritus onsite or nearby, but in addition, the mere presence of roads often fragments plant and animal habitat, preventing migrations across accustomed paths.⁴⁵ Incidentally,

43. See, e.g., POTTER, *supra* note 32, at 133 (describing Roman “ruthlessness” in building road network to bypass old Etruscan rival city, which subsequently languished).

44. See *Woodruff v. N. Bloomfield Gravel Mining Co.*, 18 F. 753, 756 (C.C. Cal. 1884) (describing great quantities of debris clogging California river as result of Gold Rush and later hydraulic mining, enjoining further deposits as impediment to navigation); John Batt & David C. Short, *The Jurisprudence of the 1992 Rio Declaration on Environment and Development: A Law, Science, and Policy Explication of Certain Aspects of the United Nations Conference on Environment and Development*, 8 J. NAT. RESOURCES & ENVTL. L. 229, 270–72 (1993) (describing modern Amazon-region goldminers or *garimpeiros*, who cut swaths through the forest, tear up streams and cause widespread mercury contamination); see also Madeline Cohen, Note, *A New Menu for the Hard Rock Cafe: International Mining Ventures and Environmental Cooperation in Developing Countries*, 15 STAN. ENVTL. L.J. 130, 141 (1996) (asserting that very small independent operators’ mineral extraction “plagues the developing world” due to environmental degradation, citing examples in Africa, Brazil, Latin America).

45. JUDITH KIMERLING, *AMAZON CRUDE* 75–77 (1991) (describing roads in Amazon as destroying vegetation directly and through waste deposits, also fragmenting habitat and disrupting animal migration paths in Amazon, as well as compacting soil); see also Jamison Colburn, *Bioregional Conservation May Mean Taking Habitat*, 37 ENVTL. L.

this fragmentation effect is certainly not unknown for human populations; witness the way that an urban freeway separates urban sub-communities from one another in any number of big cities in the United States, isolating neighborhood populations that would otherwise intermingle.⁴⁶

A second kind of environmental impact that roads exert concerns new movement into and out of road-served areas. Roads encourage out-migrations from previously undisturbed areas, perhaps most frighteningly, outward-spreading disease pathogens.⁴⁷ But migrations *into* a newly road-served community may be even more disruptive. When a new road clears the way through a forest, previously absent “edge” plants may establish themselves in disturbed soils and sunlight; these in turn damage wildlife and provide fuel for even more destructive fires, as in the Brazilian Amazon.⁴⁸

Even more potentially disruptive is the human influx into areas served by new roads. In the Ecuadorian Amazon region, when the oil firm Texaco explored for and developed oil resources, the company built numerous roads. Thereafter, with the encouragement of an Ecuadorian government anxious to relieve land hunger elsewhere in the country, numerous settlers followed the roads and cleared nearby areas of what was once forested land.⁴⁹ In Brazil’s Amazon region, major new roads have been augmented rapidly by networks of smaller secondary roads leading out to logging operations and settlers’ clearances.⁵⁰ In this way, the large public roads encourage further damaging effects of informal roads.

The reason roads encourage incursions into previously undamaged ecosystems is because they link previously remote areas to outside commercial markets. Settlers go into the forest when roads are present because they can exploit forest resources and then deliver their products to distant markets. Once on the scene, those settlers may encounter few well-enforced property rights to channel

249, 265–66 (describing development of a new professional field of “road ecology” to study impact of roads in U.S. northern forests).

46. See Nicole Stelle Garnett, *The Neglected Political Economy of Eminent Domain*, 105 MICH. L. REV. 101, 114–21 (2006) (discussing rerouting of Chicago urban freeways in the 1950s to avoid Catholic churches and some parishes, but running through other parishes as well as minority neighborhoods).

47. See, e.g., *Research from the United States Reveals New Findings on Epidemiology*, GASTROENTEROLOGY WK., Mar. 26, 2007, at 257 (reporting study of how roads in previously roadless area of northern coastal Ecuador encouraged transmission of diarrheal pathogens).

48. See William F. Laurance et al., *Rain Forest Fragmentation and the Proliferation of Successional Trees*, 87 ECOLOGY 469, 476–77, 479–80 (2006) (describing “edge effects” from deforestation); see also Phillip M. Fearnside, *The Fractured Landscape*, AM. PROSPECT, Sept. 1, 2007, at A11 (noting that logging accompanies roadbuilding and contributes to drier soils and fires).

49. Chris Jochnick, *A Seat at the Table*, in 1 NACLA REPORT ON THE AMERICAS 41 (2001).

50. Fearnside, *supra* note 48 (noting that new roads link “endogenous roads” and especially citing new highway BR-319 with planned side roads as causing forest fragmentation).

development, or they may pay little attention to any such rights that exist⁵¹—a scenario well known to encourage overexploitation of resources.⁵² In the Brazilian pattern of deforestation, roadbuilding has engendered logging that serves remote markets, but much of this activity is done illegally on indigenous or public lands or other insufficiently guarded private property.⁵³

At a later stage, logging and other short-term exploitation tends to give way to longer time-horizon activities like ranching and farming.⁵⁴ Unlike the short-termers, farmers and other long-term interest groups are more concerned to establish secure property rights, but all these groups are alike in that they all want to sell their products in outside markets.⁵⁵ Without roads (or waterway “roads”) to transport both logs and farm products to market, there would be little point either in cutting trees for lumber or in clearing land for agriculture.

On the environmental front, perhaps the most important but most subtle effect of roads is that, by linking areas commercially, roads tend to discourage local diversity in resource use. Roads expand potential market areas, and expanded markets encourage regional commercial specialization.⁵⁶ With trade across different local areas, different areas gravitate toward their respective comparative advantages. This is why environmentalists are so concerned about the paving of an international highway from the Brazilian Amazon to the Peruvian border: the Brazilian road, together with the road across Peru, will enable soybean growers of the Amazon to look to markets across the Pacific in China.⁵⁷ That fact is very likely to encourage vastly more soybean production in the Amazon—but regional

51. The California Gold Rush offers a notorious example, where miners simply trespassed on Federal public lands and murdered local Indians; however, they did manage to organize relatively short-term claims regimes for their own mining activities. See Andrea McDowell, *Real Property, Spontaneous Order, and Norms in the Gold Mines*, 29 LAW & SOC. INQUIRY 771, 771–72 (2004); see also Phillip M. Fearnside, *BR-319: Brazil's Manaus-Porto Velho Highway and the Potential Impact of Linking the Arc of Deforestation to Central Amazonia*, 38 ENVTL. MGMT. 705, 709 (2006) (noting roadside settlers' invasions of adjacent public lands).

52. For a classic treatment, see Frank Knight, *Some Fallacies in the Interpretation of Social Cost*, 38 Q.J. ECON. 582, 584–87 (1924) (comparing exploitation levels of owned and unowned resources, using examples of roads and farms).

53. See Larry Rohter, *Loggers, Scorning the Law, Ravage the Amazon Jungle*, N.Y. TIMES, Oct. 16, 2005, §1, at 16 (describing massive illegal logging, using roads for transport).

54. See Bradley S. Romig, *Agriculture in Brazil and Its Effect on Deforestation and the Landless Movement: A Government's Attempt to Balance Agricultural Success and Social Collateral Damage*, 11 DRAKE J. AGRIC. L. 81, 87–90 (2006) (noting succession from deforestation to ranching and agriculture).

55. ALSTON ET AL., *supra* note 8, at 15–16 (noting that more settled activities creates more demand for secure property rights).

56. See, e.g., Romig, *supra* note 54, at 86, 90 (attributing great growth in land devoted to cattle ranching, soybean production in formerly forested Amazon area to export markets).

57. See Lucien O. Chauvin, *Peruvian Committee to Oversee Preservation Aspects of Atlantic-Pacific Road Project*, 29 BNA INT'L ENVTL. REP., 766 (2006) (describing Inter-Oceanic Highway South project, Brazil's support to encourage agricultural and mineral exports, environmentalist concerns for impact on rainforest).

specialization in soybeans comes at the cost of losses to the ancient forest. Enlarged markets make many more products available to everyone, at prices that are generally lower because of regional specialization; but by encouraging regional specialization, roads in effect encourage a mosaic with larger pieces, i.e., internally non-diversified, commercially-linked monocultures.

The Amazon is of course not the first place to experience this drift toward regional specialization and linked monocultures. William Cronon has shown how in the nineteenth century, new modes of transportation gave Chicago a regionally specialized hinterland, with timber coming from Michigan and Wisconsin, wheat from the plains, and meat from the west—leading, of course, to the deforestation of the upper Midwest, the replacement of a diverse tallgrass prairie by grain monocultures, and the introduction of cattle ranching after the demise of the buffalo.⁵⁸ Here too, many of these activities initially ignored any indigenous land management practices, and even formal United States law.⁵⁹ Long before Chicago's development came an even more striking example of a similar set of phenomena in the long-drawn-out enclosure movement in Britain. The economic historian Carl Dahman attributes the enclosure drive to better transportation and the expansion of European markets from the sixteenth to the nineteenth century.⁶⁰ Expanded markets meant that landowners did not have to depend on an economically-diversified local community to produce a complete range of goods and services on the spot. Instead, landowners could “enclose” the village-based mixtures of individual plots and common fields, and turn these entire areas into sheep-grazing or grain-growing monocultures, trading the products all over Great Britain and abroad while the former villagers attempted to find other occupations.⁶¹

In recent years, copyright opponents have cited the English enclosure movement as a metaphor for the “privatization” or “propertization” of previously open information. Yet it was public infrastructure—roads and other transportation improvement—that lay the foundations for the enclosure of the villages and

58. WILLIAM CRONON, NATURE'S METROPOLIS: CHICAGO AND THE GREAT WEST 151–55, 200–04 (1991) (describing lumbering and deforestation); *id.* at 97–102 (describing introduction of European grains and destruction of native grasses); *id.* at 213–225 (describing demise of bison and introduction of cattle).

59. See, e.g., *id.* at 101 (describing settler farmers suppression of fire, unlike Indians, resulting in alteration of prairie landscape); KAREN MERRILL, PUBLIC LANDS AND POLITICAL MEANING: RANCHERS, THE GOVERNMENT, AND THE PROPERTY BETWEEN THEM 169–83 (2002) (noting that nineteenth century western “cattle barons” flouted US public lands laws).

60. CARL J. DAHLMAN, THE OPEN FIELD SYSTEM AND BEYOND: A PROPERTY RIGHTS ANALYSIS OF AN ECONOMIC INSTITUTION 153–70 (1980) (noting poor transport as a factor in local self-sufficient agriculture, improved transportation as a factor in economic integration and enclosure of local common fields); *see also* J. M. NEESON, COMMONERS: COMMON RIGHT, ENCLOSURE AND SOCIAL CHANGE IN ENGLAND, 1700–1820, at 220 (1993) (summarizing enclosure’s displacement of former village agricultural communities).

61. DAHLMAN, *supra* note 60, at 145–59 (describing regional specialization accompanying enclosure).

common fields in the earlier era.⁶² More than that, this public infrastructure of roads made it possible to reduce localized economic diversification. If roads link you to the world, why bother to make everything for yourself? It makes so much more economic sense to specialize in what you do best and trade for the rest.

Notice that commercial development does not undermine diversity in a broader sense, particularly with respect to consumption. Indeed, the world over, resources and products from everywhere become available in dizzying arrays. With widespread commerce, it would be no surprise to find that the residents of Tierra del Fuego follow internet-based European newscasts on a computer assembled in China. The diversity that is undermined, however, is *local* diversity, particularly in terms of production, because commerce fosters regional specialization and thus regional monocultures.

II. BIG RIGHTS—PROPERTY RIGHTS AS PUBLIC INFRASTRUCTURE

A. Does property require public infrastructure?

I turn now to the other form of public infrastructure in question, the development of modernist property rights that often follow some time after the infrastructure of roads. But first, the same question arises with property rights as arises with roads: do property rights require a public infrastructure at all? This is actually a subject of considerable philosophical importance. John Locke's famous exposition of property argued that property precedes government, and that the protection of property is both the justification for the establishment of government and the measure of its legitimacy.⁶³ Libertarian thinkers are, roughly speaking, followers of Locke in this view.⁶⁴

But *can* property rights precede government? It seems quite clear that they can, though as we shall see, they are rights of a limited character. Property rights govern relationships between people, and hence they are always a part of some social system or other, but those social systems need not be formal governments. Complete strangers participate in informal short-term property arrangements when they take places in line at a ticket window. Longer-term entitlements tend to require longer-term community understandings, but Elinor Ostrom and her admirers and collaborators have written extensively about many such community-based property regimes, which may embed quite elaborate individual entitlements.⁶⁵ These community-based regimes exist throughout the

62. See Rose, *supra* note 35, at 101 (describing and critiquing argument that intellectual property is new “enclosure” movement).

63. JOHN LOCKE, 2D TREATISE, §§ 27–36 (outlining labor theory of property); *id.* §§ 124, 127, 138 (describing government’s goal as the preservation of property).

64. See, e.g., ROBERT NOZICK, ANARCHY, STATE, AND UTOPIA 171–74 (1975) (using Lockean property rights analysis to critique idea of redistributionist state).

65. See, e.g., ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION (1990) (theory of commons plus a number of examples); THE QUESTION OF THE COMMONS: THE CULTURE AND ECOLOGY OF COMMUNAL RESOURCES (Bonnie J. McKay & James M. Acheson eds., 1990) [hereinafter THE QUESTION OF THE COMMONS] (collection of essays on various community-based management regimes); see also Alison Rieser, *Prescriptions for the Commons: Environmental Scholarship and the*

world, and some have endured for very long periods, organizing community members' access to fisheries, grazing meadows, and small-scale irrigation systems, among other things.⁶⁶

Community-based informal rights structures tend to be quite complex, however, and individual property rights within them are complicated as well. Villagers in pre-enclosure medieval England owned land in a complex structure of scattered fields that rotated in and out of common grazing; and since a major issue was the distribution of manure, the communities paid much attention to the times and locations where livestock grazed.⁶⁷ James Carrier has described the informal property rights of contemporary fishermen in Papua New Guinea, who might be entitled only to particular kinds of fish or particular kinds of netting techniques, while other fishermen have rights to other kinds of fish or techniques in the same reef—and net owners are also subject to overarching expectations that they will treat others generously.⁶⁸

Because community-based property rights structures tend to be complicated, community dispute management and resolution is complicated too, depending upon gossip, informal measures of self-help, and often upon a local bigman for consultation and decision.⁶⁹ Perhaps most important, informal property rights are not easily alienable, particularly to outsiders. The very complexity of community-based rights structures throws up barriers to trade, especially to those who are not already familiar with the system.⁷⁰ Indeed, whether intentionally or accidentally, one of the functions of these complex rights structures is to maintain the stability of the community, both in its population and in its informal governance, and that means discouraging rapid trade, especially to outsiders.

And so, the answer to whether property rights precede government seems to be yes, one may concede that property rights do precede government. But these are not the kinds of property rights that make the modern commercial world hum,

Fishing Quotas Debate, 23 HARV. ENVTL. L. REV. 393, 400 (1997) (describing Ostrom group's methodology of "institutional analysis and development" [IAD]).

66. OSTRUM, *supra* note 65, at 61–87 (describing longstanding community-based grazing and irrigation systems); *id.* at 49–52 (describing community fishery).

67. Henry E. Smith, *Semicommon Property Rights and Scattering in the Open Fields*, 29 J. LEGAL STUD. 131, 146–48 (2000) (describing elaborate ownership patterns aimed at fair distribution of manure).

68. James G. Carrier, *Marine Tenure and Conservation in Papua New Guinea*, in THE QUESTION OF THE COMMONS, *supra* note 65, at 142, 147, 158–59 (1990) (describing complex rights, distribution patterns based on generosity).

69. See, e.g., ROBERT C. ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES 55–64 (1991) (describing role of gossip and self-help in settling informal claims among ranchers, prior to resort to law); Stuart Banner, *Two Properties, One Land: Law and Space in Nineteenth Century New Zealand*, 24 LAW & SOC. INQUIRY 807, 812–15 (1999) (describing complications, role of tribal chiefs in settling rights).

70. See Banner, *supra* note 69, at 813 (describing Maori methods of claiming land as "baffling" to English settlers); see also James C. Acheson, *The Lobster Fiefs Revisited: Economic and Ecological Effects of Territoriality in Maine Lobster Fishing*, in THE QUESTION OF THE COMMONS, *supra* note 65, at 37, 44–45 (describing island communities' networks of informal rules that keep prize lobster fishing areas in hands of long-established fishing families).

and they are probably not the kinds of property rights that stimulate much interest even for modern libertarians. They are often too complex and too much embedded in particular communities to encourage trade or to create widespread opportunities for the accumulation of wealth.⁷¹

The kinds of property rights that count in a modern commercial society are the products of a public legal infrastructure.⁷² To be sure, even in commercial transactions, modernist rights are often overlaid by informal rights arrangements among people who know one another; but the basic role of modernist rights is to pry open economic activity to strangers, by offering the trump of “endgame norms” when relationship-specific, informal arrangements are not feasible.⁷³ Minimally, for long-term holdings, these rights regimes include relatively simply-defined entitlements;⁷⁴ a public recording or registration system that is available to all for inspection; some kind of effective official policing for enforcement purposes; and a dispute resolution system that can reliably enforce property rights and contractual arrangements about those rights.

B. The echoes of roads: impacts of modernist rights on traditional entitlements

Modernist property rights regimes affect traditional informal property regimes in ways that echo and extend the social and environmental effects of new roads. First of all, while modernist rights regimes have no obvious physical effects comparable to the physical alterations that roads cause in surrounding landscapes, modernist rights can work in tandem with roads to undermine preceding systems of informal entitlement and resource management, as was the case, for example, with the British enclosure movement. As new transportation routes brought the countryside inside the ambit of a wider trade, landowners bought out villagers

71. Cf. Avner Greif, *Impersonal Exchange Without Impartial Law: The Community Responsibility System*, 5 CHI. J. INT'L L. 109, 109–15, 135–37 (2004) (describing growth of medieval trade that went beyond village level, but depended on collective responsibility of all merchants from any given city; system supplanted by formal law as trade grew and merchants became more heterogeneous).

72. Libecap, *supra* note 12, at 384 (noting that governmental action is necessary to define property rights where large numbers of heterogeneous persons compete for resource); cf. ALSTON ET AL., *supra* note 8, at 15–16 (observing that secure title requires governmental action, but that governments may not always provide this security).

73. See Lisa Bernstein, *The Questionable Empirical Basis of Article 2's Incorporation Strategy: A Preliminary Study*, 66 U. CHI. L. REV. 710, 766–71 (1999) (distinguishing “relationship-preserving norms” in specific business relationships from “endgame norms” after rupture, and calling for enforcement of latter). Bernstein’s analysis suggests that formal, legal norms or “endgame norms” allow parties to deal with each other as strangers.

74. Thomas Merrill and Henry Smith have made a particular point of the necessity for simplicity where property rights are binding on wide audiences. Thomas W. Merrill & Henry E. Smith, *Optimal Standardization in the Law of Property: The Numerus Clausus Principle*, 110 YALE L.J. 1, 32–34 (2000) [hereinafter *Optimal Standardization*] (arguing that relatively simple rights are necessary in widely-marketed property rights); see also Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?*, 111 YALE L.J. 357, 385–88 (2001) (arguing that simple forms are necessary when property rights are good against the world).

voluntarily or by statutory forced sales, precisely in order to dispose of the elaborate rights structures associated with village agriculture and commons management.⁷⁵ Newly simplified land rights permitted the landowners to take over entire land areas uncluttered by all these overlapping rights and instead to devote the whole areas to local grazing or agricultural monocultures.⁷⁶ Stuart Banner's work has chronicled a similar pattern in New Zealand: in the middle of the nineteenth century, after decades of settler frustration in attempting to negotiate the complexities of land purchases from Maori communities, British settlers' courts and legislatures enabled Maori individuals to sell parcels on a "geographic" basis, without regard to the previous set of multiple overlapping informal use rights.⁷⁷ The subsequent sales of these modernist entitlements—even though voluntarily undertaken by individuals on both sides—thoroughly undermined the previous Maori informal rights structures, and as those structures sank they took clan political cohesion with them.⁷⁸ Similarly in Hawai'i, the mid-century legal changes known as the "Great Mahele" permitted non-Hawaiians to purchase land in modernist, geographic parcels, whereupon the new owners widely disregarded villagers' previous customary use claims for pasturage and gathering.⁷⁹ Likewise, pre-colonial social and economic patterns among Africans were much disrupted by the introduction of modernist colonial property regimes that fixed entitlements geographically and permitted their alienation to outsiders, contrary to prior practice.⁸⁰ This is certainly not to say that modernist rights always triumph or that traditionalist structures give way easily.⁸¹ It is just to say that these two kinds of regimes contain deep incompatibilities; the one tends toward simplicity and governs relationships with strangers, whereas the other tends toward complexity and governs relationships in close-knit groups.⁸²

In a second and related dimension, the parallel between roads and modernist rights regimes is even more striking. Just as roads allow those inside a

75. See Charles J. Reid, Jr., *The Seventeenth-Century Revolution in the English Land Law*, 43 CLEV. ST. L. REV. 221, 253–55, 258–60 (1995) (describing sixteenth century enclosures for grazing, later enclosures for agriculture, along with legal developments).

76. *Id.*; Dahlman, *supra* note 60, at 147–48.

77. Banner, *supra* note 69, at 830–32, 844–46.

78. *Id.* at 844–46.

79. See Jocelyn B. Garovoy, "Ua Koe Ke Kuleana O Na Kanaka" (*Reserving the Rights of Native Tenants: Integrating Kuleana Rights and Land Trust Priorities in Hawaii*, 29 HARV. ENVTL. L. REV. 523, 525–30 (2005) (describing Native Hawaiian loss of land and customary usages after introduction of modern property tenure); see also Stuart Banner, *Preparing to Be Colonized: Land Tenure and Legal Strategy in Nineteenth-Century Hawaii*, 39 LAW & SOC'Y REV. 273, 287–93 (2005) (describing course of the Great Mahele legislation).

80. See Bosire Maragia, *The Indigenous Sustainability Paradox and the Quest for Sustainability in Post-Colonial Societies: Is Indigenous Knowledge All That Is Needed?*, 18 GEO. INT'L ENVTL. L. REV. 197, 231–34 (2006) (describing disruption to traditional African regimes by colonial land titling).

81. See *infra* text accompanying notes 92–111.

82. Cf. Henry E. Smith, *The Language of Property: Form, Context, and Audience*, 55 STAN. L. REV. 1105, 1117–19 (2003) (noting that simple or "extensive" property rules communicate to a wide audience, whereas more detailed and complex property rules are more appropriate to small community).

previously roadless area to move out, so do modernist property rights. A villager with no more than informal, customary property rights may be unable to sell what she has at all; but when the villager acquires formal title and can sell to anyone she pleases, she can exit the community and take along the sale proceeds—a feature that may in itself encourage exit. Sometimes exit can take subtler forms as well. An urban example makes this clearer. One of the most active proponents for formal title has been Hernando DeSoto, the Peruvian economist who believes that squatter communities could enter the developed world's economy if the current informal claims can be transformed into formal land titles. The reason, according to DeSoto, is that with formal title an owner can raise capital; someone with no more than a modest cottage can use it as collateral for a loan to purchase, say, a sewing machine and start a tailoring business.⁸³ But according to one study, formal title did not so much enable squatters to borrow money as it enabled them simply to *leave*, at least temporarily, expanding their employment options by allowing them to take more distant jobs.⁸⁴ These activities were now safe because the squatter did not have to stay home to guard the house against takeover by some other squatter or a local boss.⁸⁵

There is a third and closely-related parallel between roads and modernist property rights: just as roads permit outsiders to enter a previously roadless area, formal property rights can reinforce this encouragement, particularly by contrast to community-based regimes. Community-based rights structures are generally hostile to new entry. Because these rights systems are often so complex, outsiders may not understand them, and even if they do, individual rights-holders would seldom be able to sell their rights to strangers without the approval, formal or informal, of the surrounding community. The example of the English settlers in New Zealand was described above. The settlers made little headway in acquiring land until the English themselves changed the law to allow a modernist form of property transaction—that is, individual Maori land sales, in which all that mattered was a willing buyer and a willing seller.⁸⁶ In some Alpine Swiss communities, the right to graze livestock in common fields is quite complicated, and it is not alienable at all to outsiders; grazing rights can only accrue to inherited “citizenship” that goes back to medieval times.⁸⁷ By contrast, one of the most

83. HERNANDO DE SOTO, *THE MYSTERY OF CAPITAL: WHY CAPITALISM TRIUMPHS IN THE WEST AND FAILS EVERYWHERE ELSE* 51, 57–58 (2003) (arguing that holders of secure title can use property to finance businesses).

84. Erica Field, *Entitled to Work: Urban Property Rights and Labor Supply in Peru*, 122 Q.J. ECON. 1561, 1584 (2007) (study showing that titling increases claimants' ability to work outside home).

85. See Bernadette Atuahene, *Land Titling: A Mode of Privatization with the Potential to Deepen Democracy*, 50 ST. LOUIS U. L.J. 761, n.78 (2006) (describing threats to informal squatter tenure).

86. See *supra* text accompanying note 77.

87. See ROBERT MCC. NETTING, *BALANCING ON AN ALP: ECOLOGICAL CHANGE AND CONTINUITY IN A SWISS MOUNTAIN COMMUNITY* 78 (1981) (describing how Alpine village's common field rights are available only to longstanding citizens). James Acheson's work on the “lobster gangs” of Maine offers another much-cited example: whatever the state's formal regime, the islanders' informal right to fish for lobsters is a closely guarded one, not alienable or even easily transferable; strangers cannot acquire those rights until

salient features of modernist property rights is that they are alienable to anyone. De Soto's ideas for raising capital in squatter communities rests on the supposition that individual owners can mortgage their formal property rights to outsiders like banks. Presumably if the loan fails, the bank—a stranger to the community—becomes the new owner, and presumably the bank, too, could sell to anyone.

Formal property's openness to outsiders raises yet a fourth parallel: both roads and formal property rights diminish local cultural and political diversity. When strangers buy parcels in an area where informal rights once dominated, the newcomers may or may not pay attention to local customary practice. They need not heed local dispute-resolution methods because they have the protection of larger state institutions. Local tribunals and established leaders lose their influence and political clout in the squatter communities of Ecuador,⁸⁸ as they did earlier in the Maori communities of New Zealand.⁸⁹ One may look at this phenomenon as a regrettable loss of communal decision-making, or one may look at it as a release from local tyrants, but either way, diverse local social and political organization fades where property rights open up the door to strangers.

Fundamentally, contemporary public institutions are always under some pressure to support property rights that are simple and fungible, because rights of this sort can best serve commercial markets. Modernist property rights have to fall into relatively standardized forms so that all the players are on the same page with their transactions, and—a point that Merrill's and Smith's theoretical work particularly stresses—so that none of the players has to search for idiosyncratic wrinkles of entitlement.⁹⁰ Those wrinkles would raise search costs for all potential purchasers and impede the free flow of property from lower- to higher-value uses. Many of the property categories that Blackstone noted—rights like advowsons, the privilege of nominating the local parson—have simply vanished from modernist land rights.⁹¹ And if advowsons are gone, one can be very sure that a particular villager's right to fish with a particular net in a particular spot on the beach is gone, too, along with the community dispute resolution mechanisms that would have upheld the right.

On the other hand, simplicity and standardization do not always triumph.

they have lived in the community for a long time and shown their proficiency and acceptance of local customs. JAMES M. ACHESON, THE LOBSTER GANGS OF MAINE 63–70 (1988)

88. See Jean O. Lanjouw & Philip I. Levy, *Untitled: A Study of Formal and Informal Property Rights in Urban Ecuador*, 112 ECON. J. 986, 992–93 (2002) (noting how informal urban land claims depend on local bosses); see also Atuahene, *supra* note 85, at 776–77 (land titling gives owners an escape from dependence on local bosses).

89. See Stuart Banner, *Conquest by Contract: Wealth Transfer and Land Market Structure in Colonial New Zealand*, 34 LAW & SOC'Y REV. 47, 54 (2000) (describing community chieftains' role in land sales prior to establishment of formal individual property rights).

90. Merrill & Smith, *Optimal Standardization*, *supra* note 74, at 32–34 (describing standardized forms as reducing information costs to purchasers).

91. See WILLIAM BLACKSTONE, 2 COMMENTARIES *21–24 (describing advowsons).

C. Environmental consequences of modernist rights: legal pluralism, legal triumph

What happens to the environment, then, when modernist rights enter the scene? The answer depends to some degree on the relationship of the new property regime to any informal or customary regimes that precede it. In this Section, I first briefly take up the scenario in which a modernist regime emerges but fails to displace whatever preexisting informal regimes may have been present—a situation that Daniel Fitzpatrick somewhat euphemistically dubs “legal pluralism,” and one that threatens potentially disastrous social and environmental conflicts.⁹² I then turn at greater length to the even more interesting scenario in which a modernist regime does trump all others—reducing social conflict but still entailing environmental consequences, notably the tendency toward regional monoculture.⁹³

Economists have pointed out that property regimes are far from costless.⁹⁴ Like roads, property regimes are public goods, and like all public goods, their establishment depends on politics. Indeed, however prosaic the modernist record systems and enforcement mechanisms may appear, a modernist property regime is an even more substantial achievement than a road network. Unlike roads, formal property rights may face formidable competition from informal systems. A network of old mews can scarcely put a new highway out of business. But the inertia of customary property practices, the resistance of traditionalist leaders, the self-interest of short-term entrepreneurs, and the influence of ideological or corrupt power-brokers, may all seriously undermine efforts to establish and maintain modernist property rights.⁹⁵ This is particularly the case where governmental property policies themselves are fractured and weakened by conflicting legal principals and competition among different agencies.⁹⁶ At least some of these diverging interests may strive to maintain complex informal regimes or extralegal access to resources, in opposition to modernist property rights. Thus, as Fitzpatrick has recently argued, a partially-successful modernist regime may only degrade prior methods for ordering access to resources without establishing a clear alternative, opening the door for a tragedy of the commons of conflicting claims.⁹⁷

Where resources become more accessible and hence more valuable for distant markets (as, for example, with new roads), overlapping and conflicting conceptions of entitlement can be a ticket to social conflict and economic loss. The work of Alston, Libecap, and Mueller on the Brazilian Amazon region convincingly illustrates the devastating consequences that follow where a race to

92. Daniel Fitzpatrick, *Evolution and Chaos in Property Rights Systems: The Third World Tragedy of Contested Access*, 115 YALE L.J. 996, 1022–23, 1037–38, 1040–45 (2006) (describing how incomplete introduction of formal rights may lead to conflict, overuse of resources).

93. See, e.g., Terry L. Anderson & P.J. Hill, *The Evolution of Property Rights: A Study of the American West*, 18 J.L. & ECON. 163, 163–68 (1975) (analyzing property rights systems as developing through comparison of costs and benefits); Libecap, *supra* note 12, at 380 (noting economic and political costs of property rights regimes).

94. Fitzpatrick, *supra* note 92, at 1037–42.

95. See ALSTON ET AL., *supra* note 8, at 16–22 (describing legal and institutional conflicts in property regimes in Brazilian Amazon region).

96. Fitzpatrick, *supra* note 92, at 1037–42.

develop resources occurs in the context of conflicting conceptions of property rights, consequences that include violence between new settlers and older landed interests.⁹⁷ Similar conflicts have appeared in other parts of the world. For example, in Indonesia, holders of modernist resource extraction concessions find that they face local resistance along with demands for protection payoffs from the military.⁹⁸

Serious environmental degradation is a very likely consequence of this scenario. When new arrivals and even old-timers cannot be sure of their long-term holdings, they are likely to abandon investment and instead take what they can while they can. Thus, in the worst-case scenario both socially and environmentally, the introduction of modernist property regimes degrades prior regimes while only partially supplanting them, leading to Fitzpatrick's "legal pluralism" of competing claims to entitlement.⁹⁹

What are the environmental consequences where modernist regimes take hold more fully? Does the successful supplanting of an informal, community-based rights structure substitute an environmentally indifferent regime for an environmentally friendly regime? The answer, of course, depends greatly on the prior informal regime itself. As pointed out above, a weakening traditionalist rights structure may only add to confusion and uncertainty about rights, and in that respect encourage social conflict and an accompanying loss of environmental resources. But it bears noting that even an intact and functioning traditionalist rights system may not have been particularly protective of environmental resources. Contrary to romantic notions of village or tribal life, some informal rights structures can apparently be quite damaging to the environment over time. Prehistoric people's hunting practices did not prevent anthropogenic extinctions.¹⁰⁰ In modern times, some indigenous communities appear to be indifferent to the environmental effects of their resource practices, perhaps because they do not perceive environmental resources to be scarce, or perhaps because they regard concern as disrespectful doubt of God's bounty.¹⁰¹

Where informal or customary norms only arise for the sake of short-term resource exploitation, they may be even more damaging environmentally. If the patterns of nineteenth century whaling norms are an example, customary practices may have even contributed to extinctions; the whalers' customs focused on short-term efficient hunting practices at the long-term cost of whale stocks.¹⁰² Similarly, informal entitlements among California gold miners helped them work their claims in relative peace among themselves, even as their activities trashed the landscape

97. ALSTON ET AL., *supra* note 8, at 153–54.

98. Fitzpatrick, *supra* note 92, at 1043–44.

99. *Id.* at 1039.

100. See PAUL EHRLICH & ANN EHRLICH, EXTINCTION: THE CAUSES AND CONSEQUENCES OF THE DISAPPEARANCE OF SPECIES 111 (1981) (noting finds of woolly mammoth bones together with anthropogenic hunting implements).

101. See Carrier, *supra* note 68, at 150–56 (describing Papua New Guinea's Ponam islanders' view that divine rather than human agency affects fish populations).

102. ELLICKSON, *supra* note 69, at 206.

beyond recognition.¹⁰³ These episodes are consistent with a larger pattern that anthropologist Bonnie McCay has noticed in informal property regimes: they tend to focus on managing conflict within the group and protecting the in-group from other out-groups, rather than on conserving the resource they use.¹⁰⁴

On the other hand, informal rights structures often have some conservationist features, wittingly or unwittingly, especially those that involve long-lasting contact with a particular resource base. Clearly some communities are aware of potential damage to their major resource bases, and they make conscious efforts to conserve.¹⁰⁵ Even when that is not the case, community-based regimes are frequently limited to particular groups, and because they are associated with economies that are for the most part relatively local, they tend also to operate at fairly low levels technologically.¹⁰⁶ The residents of an isolated fishing village may be completely uninterested in conservation, but their fishing customs are unlikely to have the impact on shell fisheries that a modern bottom-scraping trawler does. The fishing village keeps most of its own fish, which limits the take to something like subsistence levels, whereas the trawler's operators anticipate sales anywhere in the world, and they take what they can accordingly. Moreover, the fishing village is not likely to be wealthy; the relatively low technology levels of traditional communities limit or at least slow down the environmental impact that informal rights structures have on the environment—though, once again, over time that impact may be substantial.

How do modernist right regimes compare? Alston and his collaborators urge that titling programs—that is to say, modernist, alienable property rights—can allow landholders to borrow, invest, and generally improve land and move its use toward higher economic values.¹⁰⁷ Clearly, those results are preferable to the chaotic situation where resource users compete under pluralistic conceptions of entitlement. Nevertheless, these modernist resource uses are very likely to be commercial ones because those are the uses most salient to modernist asset holders. On the whole, owners with secure title will only consider conservationist uses if and when they are recompensed for conservation¹⁰⁸—somewhat unlikely in many instances, given the frequent non-market character of environmental goods.

103. Andrea G. McDowell, *From Commons to Claims: Property Rights in the California Gold Rush*, 14 YALE J.L. & HUMAN. 1, 17–19, 65–66 (2002) (emergence of mining claims when conflict loomed, rough though incomplete efficiency of rules); *id.* at 62 (impact of mining on soil).

104. Bonnie J. McCay, *Emergence of Institutions for the Commons: Contexts, Situations, and Events*, in THE DRAMA OF THE COMMONS 361, 370–71 (Elinor Ostrom et al. eds., 2002).

105. See, e.g., NETTING, *supra* note 87, at 78 (describing Swiss villagers' limits on grazing in common pasture).

106. See Maragia, *supra* note 80, at 221–25 (attributing low levels of ecological damage in pre-colonial societies to low levels of technology); see also Banner, *supra* note 69, at 814 (noting that pre-contact Maori society had little opportunity for wealth accumulation).

107. ALSTON ET AL., *supra* note 8, at 3, 9–13.

108. See Robert Mendelsohn & Michael Balick, *Private Property and Rainforest Conservation*, 9 CONSERVATION BIOLOGY 1322, 1323 (1995) (arguing that private property owners will follow resource uses with highest return, not necessarily conservationist).

Thus formal modernist titling, if successful, undoubtedly has salutary effects for social peace and economic growth, but the environmental consequences are more mixed; as with roads, the public infrastructure of property rights opens up more environmental resources to market exploitation, albeit a rational and longer-term exploitation.

To be sure, modernist rights-holders who depend on renewable resources can correct problems of overexploitation, and in certain respects they can probably do so more effectively than many traditionalists can. Modernist property rights allow fish farms to replace overfishing trawlers, and the fish farm operator is well aware of the dangers of overfishing, perhaps unlike the traditionalist fishers. However, even putting to one side the external environmental damage caused by fish farms,¹⁰⁹ the modernist fish farmer is part of a picture of localized monocultures; he is not a generalist but rather he concentrates on the small number of attributes of his property that will be most valuable in the very large market he serves. Farmed shrimp are sold in major cities in the developed world, with the consequence that shrimp farms have supplanted mangrove swamps on Asian coastlines.¹¹⁰ Mangrove swamps do not bring a return to the owner through trade, while shrimp farming does. Once again, as with roads, modernist property rights serve a wider commerce, wider commerce promotes specialization, and specialization promotes local monocultures.

The bottom line is that modernist property rights, like roads, are a kind of public infrastructure for what is often (and mistakenly) considered a quintessentially private activity—that is, commerce and trade. Commerce and trade are *possible* without publicly supported roads or publicly supported property rights—but public infrastructure makes these activities much easier, much more fluid, much cheaper, much more expansive, and hence vastly more productive. Expanded commerce and trade bring the many parts of world together, and they vastly enhance total wealth, but they also undermine local diversity, both social and environmental. The next question, and perhaps the hardest, is whether public infrastructure of rights can be turned around to protect environmental resources.

III. PUBLIC INFRASTRUCTURE IN SERVICE TO THE ENVIRONMENT—THE ROLE OF MODERNIST RIGHTS

Can modernist rights protect the environment? Certainly many people hope that they can, and that property rights can supplement or replace more cumbersome forms of environmental regulation. Because of the difficulty and expense of defining environmental property rights, however, and because of the diffuseness of support for environmental issues generally, these kinds of rights

109. See Mary Liz Brenninkmeyer, *The Ones that Got Away: Regulating Escaped Fish and Other Pollutants from Salmon Fish Farms*, 27 B.C. ENVT'L AFF. L. REV. 75, 75–76 (1999) (describing pollution from fish farms).

110. See Christopher F. Knud-Hansen, Comment, *Shrimp Mariculture: Environmental Impact and Regulations with a Focus on Thailand*, 6 COLO. J. INT'L ENVT'L L. & POL'Y 183, 183–84, 189–90 (1995) (describing growth of shrimp farming for international markets in less developed countries, as well as destruction of mangrove swamps).

regimes are likely to be a lagging public infrastructure. They are likely to lag first behind roads and then behind conventional property rights and then even behind other more conventional forms of regulation.¹¹¹ But the wealth that roads and modernist rights bring, together with higher values on scarce environmental goods, make environmental property rights at least thinkable.

Some environmentalist hopes involve the use of one of the most prosaic instruments of the public infrastructure of property—the recording or registration system. Other hopes focus on a new form of property right, the tradable rights created in cap-and-trade programs. I will consider both in order.

A. Private conservation restrictions

Aside from registration or recording, a venerable method to signal one's claim to land is to mark the land physically, for example by cutting trees, erecting fences, and/or farming or mining. As the common law nostrum put it, those activities constitute a declaration of one's intent to take the land for one's self.¹¹² Property marked through such physical intrusion is modernist in the sense that the markers are intended to be observable by any stranger at all (rather than only by insiders to a community) and also modernist in the sense that these kinds of property claims are presumably available to commercial transactions with strangers. Thus, when countries like Brazil and Ecuador have granted title to settlers who would make "productive" uses of what were considered underused areas in the Amazon region, they not only encouraged clearance but they also opened up to commerce those now more clearly marked regions—commerce both for their products and for the land itself.¹¹³

As economists and conservationists have pointed out, however, a land-grant policy based on physical intrusion can have devastating environmental consequences.¹¹⁴ Not only do settlers alter the natural setting, but they are also likely to fragment it into small pieces. If claims are based on physical alteration, they can only be as large as the area in which a settler can physically signal his control. Recording and registration systems obviate the need for these physical markers. Unlike physical markers, recorded or registered claims occur off-site, through paper or electronic

111. Environmental property rights generally come later than other forms of environmental regulation because the latter do not raise so directly the issues of distribution of entitlements. See Libecap, *supra* note 12, at 397; see also, e.g., Shi-Ling Hsu, *Fairness Versus Efficiency in Environmental Law*, 31 ECOLOGY L.Q. 303, 375–76 (2004) (noting that in fishing, individual quota systems lag behind other regulations like gear restrictions, and noting that gear restrictions have been easier to establish because they seemed more egalitarian).

112. 2 BLACKSTONE, *supra* note 91, at *9, *258.

113. ALSTON ET AL., *supra* note 8, at 10–11 (noting land speculation, resale by early settlers to higher-value followers).

114. See Robert Mendelsohn, *Property Rights and Tropical Deforestation*, 46 OXFORD ECON. PAPERS 750, 751, 755 (1994) (noting undue deforestation where property rights are established through physical "improvement"); Fearnside, *supra* note 51, at 714–16 (decrying deforestation that follows tradition of according property rights to squatters invading "unused" land).

records. This means that registration or recording can signal ownership that is dedicated to unintrusive or passive uses—that is to say, preservationist uses.

In the last few decades, environmentalists have come to appreciate this aspect of recording/registration systems and to generate new property forms that take advantage of recording and registration. Within the United States, many states have adopted legislation that allows for the creation of conservation easements and similar devices that allow owners to restrict land to low-intensity uses in the future.¹¹⁵ Conservation easements and similar restrictions depend critically on record systems because otherwise these passive uses have no way to signal their presence.

On a larger scale, and of more importance to retaining tropical rainforests whose destruction could add substantially to global warming, non-governmental organizations (“NGOs”) have organized not only conservation easements but a variant in the form of “debt-for-nature” swaps.¹¹⁶ These involve paying off less-developed countries’ debts in exchange for conservation restrictions in sensitive areas. These deals too depend on record-keeping to identify the lands in question and the restrictions to which they are subject, as well as enforcement to prevent violation. Once in place, however, they have the characteristic advantage of modernist rights: they are open to everyone. Conservation easements can invite investment from any person or organization in the world, a feature that can greatly expand their extent.

Obviously, recording or registration systems must be up and functioning before they can be used for conservationist purposes. That may not always be the case as new locations move inside what Alston, Libecap and Mueller call the economic frontier.¹¹⁷ Record systems may be particularly inadequate in those environmentally sensitive areas that have remained undeveloped because until recently, most people found them too remote or difficult for settlement. Indeed, malfunctioning or nonexistent record systems might be one factor in some governments’ decision to base remote-area land claims on physical markers. Another factor, however, could derive from distributional considerations; that is, an attempt to favor small-scale landownership by limiting claims to areas that

115. See John L. Hollingshead, *Conservation Easements: A Flexible Tool for Land Preservation*, 3 ENVTL. LAW 319, 335 (1997) (describing state statutes); see also Stephanie Stern, *Encouraging Conservation on Private Lands: A Behavioral Analysis of Financial Incentives*, 48 ARIZ. L. REV. 541, 567–82 (2006) (offering suggestions for improved incentives based on behavioral psychology).

116. See Andrew Wolman, *Review of Conservation Payment Initiatives in Latin America: Conservation Concessions, Conservation Incentive Agreements and Permit Retirement Schemes*, 28 WM. & MARY ENVTL. L. & POL’Y REV. 859, 865–70 (2004) (describing debt-for-nature and conservation easements); see also Kristin Hite, *Back to the Basics: Improved Property Rights Can Help Save Ecuador’s Rainforests*, 16 GEO. INT’L ENVT. L. REV. 763, 789–94 (2004) (describing advantages of conservation easements and debt-for-nature swaps, as well as possible future carbon markets); Laurance et al., *supra* note 48, at 479 (arguing that old growth tropical forests are especially significant for carbon sequestration).

117. ALSTON ET AL., *supra* note 8, at 13–14 (defining the “economic frontier” as that region where those with few other opportunities can at least break even).

individuals can clear and use, whatever the consequences to rainforest destruction and habitat fragmentation.

Institutional frailty as well as conflicting governmental motives, then, can confound efforts to establish passive land uses through modernist property rights—especially in the very remote forested regions most salient to climate change. But this is not a failing inherent in modernist property rights as such. It is rather a signal of the costs and practical difficulties of establishing modernist property in remote areas, particularly for environmental purposes.

B. Tradable environmental allowances

Whatever their practical difficulties, conservation easements represent a relatively straightforward extension of modernist property rights into the environmental arena. In connection with global warming, however, much more attention now focuses on what appears to be a more innovative extension of modernist property rights: cap-and-trade programs for greenhouse gases. As mentioned at the outset, a chief model for these programs is the United States' program for reduction of the acid rain precursor gas, SO₂, and the chief new instances are the cap-and-trade programs set out in the Kyoto Protocol¹¹⁸ and developed in the European Union, as well as in the voluntary programs of several U.S. states and Canadian provinces.¹¹⁹

These cap-and-trade institutions are an extension of modernist property concepts in that they establish formal entitlements and allow their trade to virtually anyone. How do they fare with respect to the environmentally problematic aspects of modernist rights? Earlier sections of this Article identified two particularly important and potentially problematic aspects of these big rights regimes, in two different scenarios. First, where modernist rights succeed only partially in displacing preexisting community-based resource management regimes or other informal practices, they can contribute to Fitzpatrick's "legal pluralism"—uncertain and overlapping claims regimes, together with insecurity and the accompanying short-term and environmentally devastating resource exploitation.¹²⁰ Second, where modernist rights do take hold successfully, these rights—together with the roads and other transportation systems that generally precede modernist rights—tend to produce localized monocultures in a larger trading market.¹²¹ Do those features of modernist rights affect cap-and-trade for greenhouse gases?

As to the first, legal pluralism and the potential disruption of preexisting community management or other informal regimes, greenhouse gas cap-and-trade programs would at first glance seem to present no particular problem. Prior to the programs themselves, there is no demand at all for these kinds of rights.

118. Kyoto Protocol to the U.N. Framework Convention on Climate Change, Dec. 10, 1997, U.N. Doc. FCCC/CP/1997/7 Add. 2, reprinted in 37 I.L.P. 22 (1998).

119. For a brief description, see Nadia Zakir, *Emissions Trading Initiatives: Responding to Climate Change Through Market Forces*, 16 BUS. L. TODAY 19 (July/Aug. 2007) (describing programs).

120. See *supra* Part II.C.

121. See *supra* Part II.C.

Greenhouse gases are not noticeable and not easy to monitor without technical equipment, and in addition their ill effects are extremely diffuse. Those characteristics make them an unlikely candidate for preexisting community-based management regimes, with their usually limited levels of technology and their concentration on local resources.¹²² It is certainly possible that newly minted cap-and-trade regimes could conflict with several recent smaller-scale and voluntary programs of the same sort,¹²³ but with that exception, modernist controls on greenhouse gas emissions have no rival regimes to disrupt.¹²⁴

On the other hand, when one comes to the more indirect question of offsets for carbon dioxide and other greenhouse gases, a cap-and-trade system might indeed entail disruptions to a community regime or other informal practices. This would particularly be the case if the trading system contemplates offsets for forestry management in order to create so called “carbon sinks”—extensive vegetation sites that sequester carbon dioxide terrestrially. The recent experience of pharmaceutical researchers with bioprospecting is instructive. The idea was to compensate communities for their role in conserving and identifying plants and animals with potential value for pharmaceutical products. But payments for community-based resource management have sometimes raised a multitude of conflicting claims and ill-will, suggesting that any such payment schemes need to be thought out carefully as to who gets what, and for what.¹²⁵

Moreover, the most meaningful old-growth forest reserves for greenhouse gas offsets, and those that have the greatest potential for reducing global warming,

122. Carol M. Rose, *Common Property, Regulatory Property, and Environmental Protection: Comparing Community-Based Management to Tradable Environmental Allowances*, in *THE DRAMA OF THE COMMONS*, *supra* note 104, at 233, 245–47 (noting that community-based management regimes generally have not focused on pollution, particularly outside the community).

123. See Kirsten Engel, *State and Local Climate Change Initiatives: What is Motivating State and Local Governments to Address a Global Problem and What Does This Say about Federalism and Environmental Law?*, 38 URB. LAW. 1015, 1015–20 (2006) (brief overview of state and local initiatives). In addition to Professor Engel, my thanks to Professor William Funk of Lewis & Clark Law School for this reminder about the preemption issue.

124. Cap-and-trade programs involving resource extraction, like fishing or grazing, could be very different; there are many community-based regimes about resource extraction. *Id.* One could imagine that the introduction of an individual cap-and-trade allowance system would be disruptive and produce much conflict if it were to be introduced, say, in the Monhegan Island lobster fishery. See Katrina M. Wyman, *The Property Rights Challenge in Marine Fisheries*, 50 ARIZ. L. REV. 511, 528 (2008) (noting that individual fishing quota regimes have put many fishers out of work in fishing communities).

125. See MICHAEL F. BROWN, WHO OWNS NATIVE CULTURE? 119–25 (2003) (describing chaotic results when researchers sought to compensate communities for biological knowledge and conservation); see also CORI HAYDEN, WHEN NATURE GOES PUBLIC: THE MAKING AND UNMAKING OF BIOPROSPECTING IN MEXICO 100–08 (2003) (same).

are likely to be in remote areas of the tropics.¹²⁶ But reserves in these locations present particular problems. Not only may forest reserves compete with such indigenous agricultural practices as slash and burn, but even more importantly, they compete with later-arriving informal practices of logging, poaching, and similar depredations of forest resources, often compounded by corruption of the relevant officials. All these informal local practices can render formal reserves simply one more type of claim in a chaotic scenario of conflicting entitlement regimes.¹²⁷

Monitoring and enforcement are thus critical if forestry is to count among CO₂ offsets. Perhaps just as critical is persuasion. As Gary Libecap continually stresses, those doing well under previous systems of entitlement often must be placated before new kinds of property regimes can take hold.¹²⁸ On this issue, there may be some lessons from the successes of wildlife park management in Africa, where communities have taken over wildlife management and as a result have curtailed poaching by themselves and others.¹²⁹ That is to say, insofar as they have succeeded, these wildlife management regimes have recruited a more sympathetic informal group in order to control the much less sympathetic informal group of lawbreaking poachers.

The second major problem area, the scenario in which modernist rights take hold but also encourage localized monocultures, presents somewhat different issues, and indeed reveals some of the most interesting features of cap-and-trade programs. The argument earlier was that, like roads, modernist property rights encourage trade, and trade encourages localized specialization—hence localized monocultures in resource development. Tradeable environmental rights have already been shown to have some of the same characteristics.

The well-known hotspot problem is an example: trade in pollution entitlements effectively allows specialization, which can translate into local concentrations as particular areas unwillingly “specialize” in receiving

126. Ken Caldeira, *When Being Green Raises the Heat*, N.Y. TIMES, Jan. 16, 2007, at A21 (discussing view that that northern forests may reduce carbon but also raise heat by absorbing sun's rays, while tropical forests generate heat-lowering cloud cover).

127. Fitzpatrick, *supra* note 92, at 1039–40 (describing “legal and normative pluralism” resulting from incomplete replacement of former informal regimes by formalist property system).

128. Libecap, *supra* note 12, at 385; see also GARY LIBECAP, CONTRACTING FOR PROPERTY RIGHTS 5–6 (1989).

129. The leading example is Zimbabwe’s Communal Areas Management Programme for Indigenous Resources (“CAMPFIRE”), described in Donald T. Hornstein, *Environmental Sustainability and Environmental Justice at the International Level: Traces of Tension and Traces of Synergy*, 9 DUKE ENVT'L. L. & POL’Y F. 291, 299–301 (1999). A more skeptical view of community wildlife management is presented by Alexander N. Songorwa, Ton Bührs & Ken F. D. Hughey, *Community-Based Wildlife Management in Africa: A Critical Assessment of the Literature*, 40 NAT. RESOURCES J. 603, 613–40 (2000) (assessing the sometimes incorrect assumptions of community wildlife management).

pollutants.¹³⁰ On the other hand, trading in greenhouse gas emissions should be immune from the hotspot problem. Even if Producer A purchases vast quantities of carbon emission rights from Producer B, the carbon emissions will all float upward into the same atmospheric layer, without respect to whether they come from A, B, or A and B together.¹³¹

Here again, however, there is a different story when it comes to offsets, particularly if offsets or credits are allowed for carbon sinks—that is to say, forestation and forestry management in particular localities. Insofar as modernist rights encourage this kind of local specialization, they could of course represent an environmental upside rather than a downside—and especially if the maintenance of old-growth forest cover counts as a credit, since old-growth forests can act as a kind of positive hotspot for biodiversity.¹³² The Amazon forest researcher Phillip Fearnside has argued for the maintenance of tropical rainforests in the effort to reduce climate change, particularly to reduce the enormous release of carbon that comes from their burning and transformation to other land uses, and he is a strong proponent of granting carbon credits for those existing forests.¹³³

Here, however, one characteristic of modernist property rights—the need for alienability—runs into another: the need for simplicity in alienable entitlements. Unfortunately, forestry credits are riddled with complexity. The Kyoto accords give a preview: while some forestry efforts can count as carbon credits, those credits generally go to *new* trees, i.e. forestation or reforestation projects.¹³⁴ Why does existing forest growth not count? Fearnside thinks that a major reason is the European fear that the United States will continue its gas-guzzling ways by buying up forestry credits instead of cutting emissions.¹³⁵ Perhaps there is something of that same kind of moral censoriousness in the Kyoto insistence that forestry and other so-called clean development credits meet the criterion of “additionality”—that they be some measure in addition to what was going to happen anyway.¹³⁶ Old-growth forests, no matter how much they absorb carbon, flunk additionality.

But the current Kyoto participants are not the only ones to be wary of forestry credits. Writing under the auspices of the Property and Environment Research Center (“PERC”), a free-market environmental organization that is normally very optimistic about property rights, Brandon Scarborough argues that we should give up on forestry credits in the effort to cut greenhouse gases,

130. See James Salzman & J.B. Ruhl, *Currencies and the Commodification of Environmental Law*, 53 STAN. L. REV. 607, 628–29 (2000) (describing hotspot problem and environmental justice concerns).

131. *Id.* at 627.

132. *Id.* at 657, n.140 (using the phrase “biodiversity hotspot”).

133. Philip M. Fearnside, *Saving Tropical Forests as a Global Warming Countermeasure: An Issue That Divides the Environmental Movement*, 39 ECOLOGICAL ECON. 167, 171 (2001) (describing greenhouse gas release from deforestation).

134. Dennis D. Hirsch, *Trading in Ecosystem Services: Carbon Sinks and the Clean Development Mechanism*, 22 J. LAND USE & ENVT'L. L. 623, 629–30 (2007).

135. Fearnside, *supra* note 133, at 171, 177.

136. Hirsch, *supra* note 134, at 630.

principally because it is too hard to define the entitlements.¹³⁷ Among other things, trees of different types and in different locations vary tremendously in their contributions to climate change control efforts, Scarborough says, and in the end it is just not worth the effort.¹³⁸ On this view, forestry credits cannot be made simple, and if they cannot be made simple, they cannot become the subjects of modernist, tradable property rights.

Notice that the destruction of tropical rainforests is by no means irrelevant to global climate change. Quite the contrary, forest conflagrations are a major contributor to atmospheric carbon dioxide.¹³⁹ Moreover, forest conservation, particularly in the tropics, serves the double function of biodiversity protection, while payments for tropical forest conservation could offer much-needed assistance to the conservation efforts of some impoverished less-developed nations. But forest conservation clearly poses a challenge to a modernist property rights structure like cap-and-trade. As with many resources that are difficult to measure and monitor, credits for forestry conservation are very likely to entail accepting rough proxies (e.g., acres of trees) that only imperfectly capture the attribute of greatest concern—that is, greenhouse gas sequestration—and that only imperfectly compare it with alternative reduction methods.¹⁴⁰

Another factor needs to be borne in mind about the use of modernist rights for environmental ends. Ultimately, both conservation easements and cap-and-trade regimes engage modernist property rights in an enterprise very different from the traditional tasks served by public infrastructure for roads and rights. Conservation areas are very likely to be literally roadless, just as their products are largely immune from the inroads of buying and selling. Indeed, the same commerce-blocking phenomenon occurs in cap-and-trade programs themselves. The “trade” aspect of cap-and-trade is very much within the modernist property frame—fungible entitlements, traded to anyone at all in open commercial markets. But the “cap” aspect is not at all a part of modernist property conventions. The cap is akin to a roadless area: it is a portion of the resource in question that is *not* to be bought and sold, but rather held as a kind of reserve.

This closure to commerce is quite foreign to the usual object of rights and roads. To be sure, closure to commerce may not be so problematic for conservation reserves or trusts, especially smaller ones. After all, property owners have long exercised their private tastes for passive resource uses by saving parks and gardens. But larger conservation reserves will entail many more issues of monitoring and policing, as well as basic definitions of the ends to be served.

137. Brandon Scarborough, *Trading Forest Carbon: A Panacea or Pipe Dream to Address Climate Change?*, PERC POLICY SERIES PS-40, 7–10, 20 (July 2007), available at <http://www.perc.org/pdf/ps40.pdf>.

138. *Id.* at 4, 20.

139. See, e.g., Laurance et al., *supra* note 48, at 479–80 (describing impact of forest fires on global warming).

140. See Carol M. Rose, *From H₂O to CO₂: Lessons of Water Rights for Carbon Trading*, 50 ARIZ. L. REV. 91, 108–09 (2008) (describing difficult choices when treating hard-to-measure resources as property); see also Hirsch, *supra* note 134, at 637–38 (noting difficulties).

As to cap-and-trade, unused air is a very large resource, and capping its use entails treating the capped portion as something like public property—a very, very large public property. There are indeed other large public properties, such as the public lands in the United States, but their history is not entirely auspicious. Though the public may “own” the public lands, the public does not speak very clearly about its interests as a general matter, and in the meantime, there are large numbers of special interests who have detailed reasons why their own uses should not be excluded after all. Although there has been much written on the “public trust” in recent decades, the concept of a public trust has no well-developed theoretical implications for most public property—except, ironically, the use of public property for those venerable levers of commerce, waterways, and roads.¹⁴¹ It is a straw in the wind that cap-and-trade programs have all adopted caps based either on the status quo (as in “no net loss” of wetlands) or on some rollback from current levels (as in the Acid Rain legislation or the initial round under the Kyoto accords for CO₂ reduction). There is no compelling theory that drives a more coherent version of the public trust in a capped resource.

Environmental property rights regimes, then, entail a departure from the standard goals not only of roadbuilding but also of modernist property regimes. Their closure to commerce leaves a conceptual gap as to what is to be done with the blocked-off aspects, as well as a threat emanating from the usual villains of public choice stories. This may be one reason why environmentalist concerns have often turned to regimes involving what I have called “fuzzy rights.”¹⁴²

C. Fuzzy Property Rights

Fuzzy property rights are the creatures of regimes like environmental impact review and negotiated regulations; that is, legal regimes that bring many interests to the table, that recognize some kind of incomplete consultative rights in all the stakeholders and that indeed require a considerable amount of consultation and double-checking. All this negotiation tends to damp down the rapid pace of commerce rather than speed it up, and it also turns to what are effectively political solutions for property uses.

In one sense, fuzzy property in environmental law is itself a modernist phenomenon because its consultative practices derive not from long customs but rather from the public infrastructure of legislation, regulation, and judicial enforcement. But in another sense, fuzzy property rights are not modernist at all, or if they are, they constitute a modernist formalization of the practices common in

141. Like other theories of public property, the public trust theory is most coherent for roads, waterways, and communication channels. See Rose, *supra* note 24, at 774 (noting that traditional doctrines of inherently public property revolved around transportation, communication, and commerce); see also Carol M. Rose, *Joseph Sax and the Idea of the Public Trust*, 25 ECOLOGY L.Q. 351, 359–60 (1998) (same).

142. Carol M. Rose, *Property in All the Wrong Places?*, 114 YALE L.J. 991, 1003–07 (2005) (book review) (describing one kind of property as “fuzzy rights”).

informal property regimes, where entitlements are not well-defined but are rather settled in the give-and-take of roundabout negotiations and tacit understandings.¹⁴³

It should be observed that environmental law is not the only area where one sees the infrastructure of modernist property shaping fuzzy property regimes. Intellectual property, for example, is itself a modernist invention, a creature of a public infrastructure of property rights, but it includes a number of somewhat hazy exceptions for other users, as for example “fair use” in copyright. The anthropologist Michael Brown, concerned about the impact of modernist intellectual property on respect for indigenous groups and their practices, has called for even fuzzier property in the usual domains of copyright, trademark, and patent, so that cultural entitlements can be settled not just through the rapid processes of commerce, but also through the more leisurely processes of consultation and negotiation.¹⁴⁴

Fuzzy property, like other complex rights regimes,¹⁴⁵ is most likely to be deployed under circumstances where resource uses overlap in complicated ways and where precise allocation of individual entitlements would raise exorbitant definitional costs. Under those circumstances more consultative regimes may actually be a less costly form of resource management. Small wonder, then, that as more persons claim an interest in the United States’ public lands, our public lands policy has come to include a large dose of fuzzy rights in the form of environmental assessments and consultative planning. With respect to global warming, one might expect the most serious applications of fuzzy property in connection with, once again, forestry reserves, where there are multiple claimants and where exact inputs and outputs of gases are most difficult to assess.

But in a certain sense, the cap on greenhouse gases is itself a meta-fuzzy property. Insofar as the greenhouse gas cap approximates a public property, it is to be expected that this cap too—and particularly its consistency and its allowable offsets and credits—will be subject to many of the fuzzy characteristics of deliberation and delay, through a kind of worldwide political process. Indeed, it has been assumed from the outset of climate change negotiations that multiple participants would be involved, including not only governments but also NGOs, and the deliberative process has already begun, as the world’s numerous claimants jockey for position on the cap’s size and makeup.

There are two chief concerns here. The first is that more traditional fuzzy property regimes have normally worked best in smaller-scale customary groups whose members lead intertwined lives and who can influence one another by

143. See generally ELLICKSON, *supra* note 69, at 67–81 (describing informal give-and-take with respect to property issues in close-knit community).

144. Brown, *supra* note 125, at 143–72, 233–34, 247 (extolling negotiated solutions); see also Rose, *supra* note 142, at 1005–06 (describing Brown’s position as a move toward fuzzy rights).

145. Cf. Henry E. Smith, *Exclusion Versus Governance: Two Strategies for Delineating Property Rights*, 31 J. LEGAL STUD. 453, 480–81 (2002) (describing complex property rules to deal with complicated interactions in medieval common fields (citing Henry E. Smith, *Semicommon Property Rights and Scattering in the Open Fields*, 29 J. LEGAL STUD. 131 (2000))).

mutual informal sanctions and reputation.¹⁴⁶ The modernist extension of fuzzy consultative rights to very large numbers, with highly heterogeneous interests and few mutual reputational anxieties, raises the specter of the “anti-commons,” the situation in which so many claimants can veto one another that the resource winds up in stasis.¹⁴⁷ The second and related concern is that with respect to controlling greenhouse gases, any such stasis could delay action to a point where action is futile. Both are serious concerns, not entirely overcome by the conceit that organized governments and NGOs will consolidate the concerns of their citizens and act as their spokespersons.

Over the longer run, however—if we can get to a longer run—there could be some benefits from deliberative processes for controlling greenhouse gases. We learn from ecological studies that complexity in an ecosystem may slow rapid adaptation, but complexity also enhances the resilience of an ecosystem as a whole.¹⁴⁸ Complexity in human affairs, and in public property management in particular, may have some of the same tendencies—resisting rapid adaptation but also enhancing resilience over a longer run. But once again, the most pressing issue will be to get to a longer run, given the numbers and heterogeneity of interests involved.¹⁴⁹

CONCLUSION

Modern roads and rights both represent versions of public infrastructure. Roads and rights have many of the same kinds of impacts on surrounding ecosystems, particularly in reducing local diversity, and indeed, roads and rights reinforce each other in causing those impacts. But at the same time, in serving commerce, roads and rights help to create the social wealth and taste that can be turned to environmental purposes.

One paradox of modern environmentalism is that the very public infrastructure that created a felt need for environmental protection in the first place is now being called upon to satisfy that need, particularly in the form of new property regimes. Nevertheless, we scarcely have any choice except to meet this call by a robust public infrastructure of newly modeled rights. Modernist property devices, ranging from recording systems to tradeable environmental allowances to fuzzy property, may all be adapted to protect environmental resources. But these

146. ELLICKSON, *supra* note 69, at 177–78, 181–82 (predicting development of efficient social practices in “close-knit groups,” whose members know about one another’s actions and can sanction them; small size is normal though not essential); see also OSTROM, *supra* note 65, at 75–76 (noting that in ancient and still-extant irrigation systems in eastern Spain, low fines are generally levied for overuse infractions, since farmers are sufficiently controlled by embarrassment).

147. See Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 667 (1998) (describing “anticommons”).

148. David Adelman & Kirsten H. Engel, *Adaptive Federalism: Lessons From the Study of Complex Adaptive Systems*, MINN. L. REV. (forthcoming 2008) (applying ecological theory to federalism).

149. See Libecap, *supra* note 12, at 386–87 (describing greater difficulties of international negotiations for alterations in property regimes).

adaptations reflect the underlying paradox, in that they dramatically alter the commercial goals that roads and rights have so long served. Environmental issues test modernist property rights' capacity to make these adaptations—and no test will be more critical than that of dealing with climate change.