WHO IS THE INVADER? ALIEN SPECIES, PROPERTY RIGHTS, AND THE POLICE POWER

By Mark Sagoff

I. Introduction

Everyone has seen popular articles that lament the scourge of invasive species. A recent issue of *Newsweek* carried a typical story titled, "Attack of the Aliens: Migrating Species May Be the Biggest Threat to Plant and Animal Life on the Planet."[1] Since any species may migrate and because more and more plants and animals are traveling in the wake of human activity, one may wonder if the biggest threat to plant and animal life on the planet is plant and animal life on the planet. What does all this planetary mixing mean for us?

This essay examines the extent to which science-based laws intended to control invasive species may restrict personal liberties and property rights. I begin by describing the legal framework—which has a long history—through which governments in the United States properly exercise the police power to control or eradicate plant and animal nuisances and pests. I then examine efforts by the National Invasive Species Council and analogous state agencies to develop management plans to protect "natural ecosystems" from non-native species. I argue that these efforts are largely unjustified and thus likely to fail. They represent the attempt by a scientific community to validate or vindicate through legal enforcement its conception of the way nature ought to be—in defiance of the way nature is.

II. Harm to the Environment

In the United States, on most accounts, the Centers for Disease Control (CDC) and the Animal and Plant Health Inspection Service (APHIS), among other organizations, deal effectively with organisms that threaten human health and agricultural and other significant economic interests. If these agencies fall short, they may need better leadership or more money, but they do not require greater legal authority. Public statutes provide all the authority these agencies need to protect human health and economic interests from threats posed by pests, pathogens, and other harmful organisms.

[1] Mac Margolis, "Attack of the Aliens: Migrating Species May Be the Biggest Threat to Plant and Animal Life on the Planet," *Newsweek,* January 15, 2007.

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For example, the Lacey Act, initially enacted in 1900 primarily to regulate the importation of wild birds, has been amended several times and now controls the importation of any wildlife deemed "injurious to human beings, to the interests of agriculture," and to natural resources. Under the Lacey Act (as amended in 1981) the Department of the Interior (DOI) allows any exotic species to be imported unless designated as "injurious." To designate a species as "injurious," the Fish and Wildlife Service (FWS) of DOI must complete a petition-and-review process that places the evidentiary burden on those who argue that a plant or animal poses a hazard.[2] As a result, the so-called FWS "dirty list" or "black list" comprises several dozen animal species known or shown to be injurious to some important economic interest in the United States or elsewhere.[3] The U.S. Department of Agriculture (USDA), under the Plant Protection Act (2000), lists about ninety-five species and two genera as "noxious weeds" in agriculture.[4]

Ecologists and other environmental professionals urge governmental agencies to adopt a "guilty until proven innocent" or "clean list" approach which recommends that "every proposed introduction be viewed as potentially problematic until substantial research suggests otherwise."[5] The Environmental Law Institute (ELI) explains, "The clean list approach . . . generally presumes that all species should be prohibited unless they have been officially determined to be 'clean,' " in that they "will not pose any economic or environmental threat."

In its "Model State Law," ELI takes a "clean list" approach.[6] Its model legislation makes every landowner responsible for controlling or eradi-

[2] To determine that a species is "injurious," USDA completes a review process including the following steps: petition or initiation of an evaluation; notice for information; proposed rule; economic analysis; and final rule. For a flow chart annotating this process, see http://www.fws.gov/contaminants/ANS/pdf_files/InjuriousWildlifeEvaluationProcessFlowChart.pdf.

[3] A complete list can be found in the *Federal Register* at http://www.fws.gov/contaminants/ANS/pdf_files/50CF_16_10-05.pdf.

[4] Noxious Weed Regulations, 7 C.F.R. 360.200 (2008). The Plant Protection Act became law in 2000 as part of the Agricultural Risk Protection Act.

[5] Daniel Simberloff, "Impacts of Introduced Species in the United States," *Consequences* 2, no. 2 (1996). See also J. L. Ruesink, I. M. Parker, M. J. Groom, and P. M. Kareiva, "Reducing the Risks of Nonindigenous Species Introductions: Guilty Unless Proven Innocent," *BioScience* 45 (1995): 465–77.

[6] Environmental Law Institute (ELI), *Invasive Species Control: A Comprehensive Model State Law* (Washington, DC: Environmental Law Institute, 2004). See p. 7. In a study published in May 2007, ELI reviews statutes state-by-state and finds that no state has fully adopted the "clean list" approach, although the study praises Michigan, in particular, where the law "encourages action because it does not require listing by the agency as a prerequisite to control actions. Similarly, the automatic declaration of all pests and pest hosts as a public nuisance provides a solid base for both avoiding compensation for control actions and for requiring abatement." Environmental Law Institute and the Nature Conservancy, "Strategies for Effective State Early Detection/Rapid Response Programs for Plant Pests and Pathogens," published online May 2007. An electronic retrievable copy (PDF file) of this report may be obtained at no cost from the Environmental Law Institute Web site, www.eli.org;

cating all non-native species that are not permitted by the state's invasive species council.[7] In its legislative guidance, ELI recommends:

> An effective state program affirmatively declares that all non-native invasive species are subject to regulation, thereby regulating all categories of species, including wildlife, aquatic life, plants, insects, microorganisms, and pathogens. States may also use the definition of "invasive" to expand coverage of the laws and regulations beyond those species that impact agriculture to those that cause harm to the natural environment. . . .[8]

While no state has fully adopted the ELI model legislation, many states empower noxious weed or invasive species committees and councils to list as injurious non-native species thought to cause harm to the natural environment, not just those that threaten human health or economic interests. In these states, official lists of "noxious weeds" include plants considered to be threats to native species or to the ecosystem, even if they have no effect on agriculture.

Pennsylvania, which is typical in this respect, empowers its department of agriculture to order landowners to eradicate "noxious weeds" on their property. The weeds must first be listed as "noxious" after hearings before the Noxious Weed Control Committee. The Pennsylvania list comprises plants like purple loosestrife thought to be bad for the natural environment as well as plants like marijuana thought to be bad for public health or morals.[9] "The department may issue an order requiring an individual landowner to implement control measures for noxious weeds and if a landowner fails to comply with an order, the department will do so" at the landowner's expense. "Any landowner who fails to comply . . . is guilty of a summary offense."[10]

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click on "ELI Publications," then search for the "Strategies for Effective State Early Detection" report. Quotation at p. 50.

[7] Environmental Law Institute, *Invasive Species Control*, 33. "A person owning private lands, waters or wetlands, or a person occupying private lands, waters or wetlands, or a person responsible for the maintenance of public lands shall control or eradicate all unpermitted introductions, populations or infestations of prohibited, restricted or regulated invasive species on the land."

[8] Meg Filbey, Christina Kennedy, Jessica Wilkinson, and Jennifer Balch, *Halting the Invasion: State Tools for Invasive Species Management* (ELI Project No. 020101, 003108) (Washington, DC: Environmental Law Institute, August 2002), 8. Available online at http://www2.eli.org/research/invasives/pdfs/d12-06.pdf.

[9] The list of weeds "it is illegal to propagate, sell, or transport" in the Commonwealth of Pennsylvania can be found at http://www.agriculture.state.pa.us/agriculture/lib/agriculture/plantindustryfiles/NoxiousWeedControlList.pdf.

[10] State of Pennsylvania, Department of Agriculture, "Noxious Weed Law Summary" (last modified January 18, 2007), http://www.agriculture.state.pa.us/agriculture/lib/agriculture/plantindustryfiles/NoxiousWeedLawSummary.pdf.

In Nebraska, "It is the duty of each person who owns or controls land to effectively control noxious weeds on such land." [11] If the landowner does not act within ten days to eradicate the weeds, "the control authority may enter upon such property for the purpose of taking the appropriate weed control measures. Costs for the control activities of the control authority shall be at the expense of the owner of the property." [12] None of the weeds listed by USDA as agricultural pests appears on the Nebraska Noxious Weed List. The Nebraska list includes plants thought to harm natural areas—plants such as purple loosestrife, saltceder, and Canada thistle. Phragmites, a common reed in wetland environments, is ubiquitous in Nebraska; one variety, hard to distinguish from the others, was found to be non-native and thus designated as "noxious": "Phragmites is present in Nebraska landscapes as a native plant; this designation covers non-native phragmites only." [13]

An ordinance controlling noxious weeds makes sense if it protects public health or important economic interests. Yet in many states the "noxious" or controlled list includes for the most part plants no one believes (even mistakenly) to be a threat to health or agriculture—such as purple loosestrife and Japanese honeysuckle. These plants, which perfume the air with beautiful blossoms, are often enjoyed by those on whose land they grow. The Pennsylvania Noxious Weed Control List names purple loosestrife just after marijuana among plants targeted for control or eradication. A state document explains that purple loosestrife is "invasive" and "harms the environment." It "crowds-out native plant species and decreases the population of animals that are dependent upon native plant species for survival." [14]

[11] Title 25, Chapter 10, Nebraska Administrative Code—Noxious Weed Regulations, http://www.agr.state.ne.us/regulate/bpi/actbb.htm.

[12] Ibid.

[13] Press Release, Nebraska Department of Agriculture, August 7, 2007, http://www.agr.ne.gov/newsrel/august2007/phragmites.htm.

[14] State of Pennsylvania, Rules and Regulations, Department of Agriculture, [7 PA. CODE CH. 110] "Noxious Weeds" [27 Pa.B. 1793]; available online at http://www.pabulletin.com/secure/data/vol27/27-15/549.html.

The belief that a non-native "generalist" or "weedy" species must "crowd out" native species adapted to particular environments, while a consequence of prevailing theory, has little empirical support. The difference between "generalist" and "specialist" species indicates poles of a spectrum; no one has shown that biologists would agree, if tested, where on the spectrum each of a random selection of species would lie. The empirical evidence does not generally show that "weedy" species crowd out "specialists"; that they do seems to be a consequence of definitions. (If species *A* crowds out species *B,* then *A* is to that extent "weedy.") Suppose purple loosestrife is "r-selected" or "weedy." Substantial evidence suggests that it does not crowd out but actually improves habitat for other species. (Loosestrife was initially introduced to support honeybee populations.) For studies that demonstrate the beneficial role of loosestrife in the natural environment, see, for example, M. G. Anderson, "Interactions between Lythrum Salicaria and Native Organisms: A Critical Review," *Environmental Management* 19 (1995): 225–31; and M. A. Treberg and B. C. Husband, "Relationship between the Abundance of *Lythrum salicaria* (Purple Loosestrife) and Plant Species Richness along the Bar River, Canada," *Wetlands* 19 (1999): 118–25. Two researchers have

A long legal tradition allows the use of state power to compel landowners to manage their property so that they do not harm others. The hoary principle *Sic utere tuo ut alienum non laedas* (Use your property so as not to harm others) creates the "nuisance" exception to the general rule, established through the Fifth Amendment of the U.S. Constitution, that the state cannot take private property for public use without paying just compensation.[15] On what concept of harm and on what theory of nuisance does the ELI rely when it recommends that state agencies "use the definition of 'invasive' to expand coverage of the laws and regulations beyond those species that impact agriculture to those that cause harm to the natural environment"?

What is "harm to the natural environment"? How is it measured? Are non-native species so evil—and those who permit their presence so antisocial—as to trigger the nuisance exception to the "takings" provision of the Constitution? Many states—like Nebraska and Pennsylvania—protect the natural environment with laws that make landowners responsible for ridding their property of a laundry list of non-native species. What public interest do these laws serve?

III. *Miller v. Schoene* (1928)

To answer these questions, it is useful to recall how courts have dealt with ordinances that control plants and other organisms that threaten major agricultural crops.[16] Red cedar trees, along with the rust they harbor, existed in Virginia before the European settlement. Apple trees, an introduced species, were widely planted in Virginia after 1900, when the railroads and refrigeration made apples the leading export crop. Cedar rust, a heteroecious fungus, requires for its life cycle both cedar trees and

concluded that ecologists "traced the history of purple loosestrife and its control in North America and found little scientific evidence consistent with the hypothesis that [it] has deleterious effects. . . . Loosestrife was initially assumed to be a problem without actually determining whether this was the case. . . . [T]here is currently no scientific justification for the control of loosestrife. . . ." H. A. Hager and K. D. McCoy, "The Implications of Accepting Untested Hypotheses: A Review of the Effects of Purple Loosestrife (*Lythrum salicaria*) in North America," *Biodiversity and Conservation* 7 (1998): 1069–79. For further confirmation, see E. J. Farnsworth and D. R. Ellis, "Is Purple Loosestrife (*Lythrum salicaria*) an Invasive Threat to Freshwater Wetlands? Conflicting Evidence from Several Ecological Metrics," *Wetlands* 21 (2001): 199–209; J. A. Morrison, "Wetland Vegetation before and after Experimental Purple Loosestrife Removal," *Wetlands* 22, no. 1 (2002): 159–69; and M. B. Whitt, H. H. Prince, and R. R. Cox, Jr., "Avian Use of Purple Loosestrife Dominated Habitat Relative to Other Vegetation Types in a Lake Huron Wetland Complex," *The Wilson Bulletin* 111 (1999): 105–14.

[15] For discussion, see Ellen Frankel Paul, *Property Rights and Eminent Domain* (New Brunswick, NJ: Transaction Books, 1987), esp. chapter 2, "The Genesis and Development of Eminent Domain and Police Powers," 71–184.

[16] In the agricultural cases discussed here, it is assumed that a major agricultural industry in a state (e.g., apples or citrus) is affected with a "public interest," not simply a private one. This assumption, which is reasonable, distinguishes these cases from *Kelo v. City of New London,* 545 U.S. 469 (2005), where it seems at least as plausible to suppose that only a private interest (that of certain developers) was served.

another species (preferably apple trees) close enough that the wind can carry spores back and forth between them. It kills the apple trees but is harmless to the cedars other than to produce galls.

In 1914, the Virginia House of Delegates responded to the needs of apple growers by enacting unanimously the Cedar Rust Act to allow the state entomologist—at the time of the legal action, W. J. Schoene—to order the destruction of any red cedar tree threatened by cedar rust that grew within two miles of an apple orchard. Nearly everyone in Virginia recognized that the economic value of apple orchards dwarfed that of red cedars, which grew wild and were useful primarily as fire wood. Nevertheless, the Cedar Rust Act, at the suggestion of apple growers, created a fund to compensate owners of particularly valuable cedar trees. Orchardists typically paid the costs of cutting wild red cedars on the lands of neighbors, stacked the firewood for them, and taxed themselves to support the fund used to compensate for the loss of large ornamental trees.[17] According to James Buchanan, in this kind of context, compensation represents "the only test for efficiency that can be instituted politically."[18]

William A. Fischel, in a masterful scholarly study of *Miller v. Schoene* (1928),[19] notes that although no cedars were grown commercially within range of an apple orchard, "the orchardists' coffers were in danger of being drained by opportunistic claims from landowners whose cedars usually had more value cut than standing."[20] Fischel cites several documents that describe many dubious claims by landowners to compensate them for cedars they suddenly discovered to have aesthetic value. Apple growers feared that inflated claims and the transaction costs involved in settling them would drive their special orchard taxes "to heights that would make cedar rust seem preferable."[21] To avoid prohibitive appraisal and adjudication costs, the state settled on allowing property owners who lost large ornamental trees a flat payment of one or two hundred dollars.[22]

Dr. Casper Miller, who as a member of the House of Delegates had voted for the Cedar Rust Act, later sued to have it declared unconstitutional. Miller sought to retain two hundred cedar trees that were large

[17] Resolutions, 2 Va. Fruit 159, 165 (1914) [18th VSHS (Jan. 1914)]. Sections 891 and 892 stipulate the proceeding to "determine the amount of damages" and the method by which apple growers will be taxed to pay that amount.

[18] James M. Buchanan, "Politics, Property, and the Law: An Alternative Interpretation of Miller et al. v. Schoene," *Journal of Law and Economics* 15 (1972): 438–52; quotation at 447–48. According to Buchanan (ibid., 443), "what is relevant is the necessary place of compensation in the trading process between the two parties." Buchanan follows Justice Stone in mistakenly believing that no scheme for compensation was enacted by the state.

[19] *Miller v. Schoene,* 276 U.S. 272 (1928).

[20] William A. Fischel, "The Law and Economics of Cedar-Apple Rust: State Action and Just Compensation in *Miller v. Schoene*," *Review of Law and Economics* 3, no. 2 (2007): 133–95; quotation at 134.

[21] Ibid., 173.

[22] The state also paid for cutting the trees, stacking the wood, and cleaning the area. For details, see *Bowman v. Virginia State Entomologist,* 128 Va. 351 (November 18, 1920).

and ornamental and added more value to his property than the $100 he would have received as compensation. "The statute is invalid," his counsel argued, "in that it provides for the taking of private property, not for public use, but for the benefit of other private persons."[23] Justice Harlan Fiske Stone, who wrote the opinion of a unanimous Supreme Court, relied on the decision of the Virginia Supreme Court to interpret the Cedar Rust Act. Justice Stone wrote, "Neither the judgment of the court nor the statute as interpreted allows compensation for the value of the standing cedars. . . ."[24] He upheld the statute nevertheless on the grounds that "the state does not exceed its constitutional powers by deciding upon the destruction of one class of property in order to save another which, in the judgment of the legislature, is of greater value to the public."[25]

The Court rested its opinion on its finding that the Cedar Rust Act served a public purpose (the overall economy of the Commonwealth) rather than a private interest (the profits of a group of apple growers), as Miller contested it did. Justice Stone refused to "question whether the infected cedars constitute a nuisance according to the common law, or whether they may be so declared by statute."[26] Justice Stone paid attention instead to the tortuous legal process, which worked on the county level and required "a request in writing of ten or more reputable freeholders," even to begin an inquiry in which the state entomologist investigated the cedar trees in a locality and determined whether they must be destroyed.[27] In view of the local focus of each inquiry, involving neighbors who had to continue to live together, and the availability of appeals and reviews, the Court refused to overturn the Cedar Rust Act on due process grounds.

Even if apple-growing was essential to Virginia's economy and the act thus served a public purpose, however, there was nothing antisocial about allowing cedar trees on one's land. Why, then, was Justice Stone willing to let one party (the apple growers) condemn without compensation the cedar trees of another (their neighbors) who were innocent of conniving at harm? Since there is nothing "wrong" about cedars, which grow wild

[23] *Miller,* 276 U.S. 272, 273. In *Miller v. State Entomologist* (146 Va. 175; 135 S.E. 813; 1926 Va.), the Virginia Supreme Court rejected several other reasons Dr. Casper Miller alleged as invalidating the law on constitutional grounds, among which were the vagueness or indefiniteness of one of its uses of the term "locality" and the possibility that it empowered citizens (the farmers who complained about his trees) to make law.

[24] *Miller,* 276 U.S. at 278.

[25] Id. at 279.

[26] Id. The Virginia Supreme Court had written, "The statute, so far as it relates to damages, is not clear, and we are to gather the intention of the legislature as best we can from a consideration of it as a whole." *Miller v. State Entomologist,* 146 Va. 175, 192 (1926). The Virginia court construed compensation under the law to consist primarily in the state paying the costs of cutting, stacking the wood, and cleaning the area. "No doubt the legislature deemed such outlays as proper damages and expenses to be paid to the owner, if the circuit court deemed them proper" (id. at 193–94).

[27] *Miller,* 276 U.S. at 278.

all over the state, one might ask whether (1) Miller should have been paid for the value of his ornamental trees, or (2) apple growers should not have planted orchards within two miles of them.

As one might expect, there is a large literature on this question. It is commonplace to cite Ernst Freund, who in *The Police Power: Public Policy and Constitutional Rights* (1940) states: "Where property is destroyed in order to save property of a greater value, a provision for indemnity is a plain dictate of justice and of the principle of equality."[28] The background principles of common law suggest that one party cannot use the law to condemn the property of another even if its interest is so much greater that the public good is thus served; rather, compensation is required. In this light, Richard Epstein has argued that Miller should have been compensated for his loss because cedar trees are innocent or passive conduits of the rust.[29] Although he is sympathetic with this principle, William Fischel has shown that the orchardists did pay a tax to compensate owners of valuable cedar trees. "The moral hazard problem," he argues, "undercut full compensation." The expectation of compensation served, in fact, to make landowners opportunistic. "A landowner who expects to be compensated for the cutting of her cedars might, instead of suppressing them, let them grow or even encourage them" to increase his or her compensation.[30]

Justice Stone was mistaken in his belief that the Cedar Rust Act did not provide compensation for especially valuable trees.[31] The act created a fund through which apple growers tried to compensate landowners for large ornamental cedars. The fund created an incentive, alas, for landowners seeking compensation to let otherwise worthless and infected trees grow larger. The problem of moral hazard—not the intention, wording, or history of the Cedar Rust Law—prevented Miller from receiving just compensation for his losses.

IV. Citrus Canker

When an agricultural pathogen or pest spreads within a single species, the situation is different. All those who grow that plant or animal share an

[28] Ernst Freund, *The Police Power: Public Policy and Constitutional Rights* (Chicago: University of Chicago Press, 1940), section 534, p. 565.

[29] Richard A. Epstein, *Takings: Private Property and the Power of Eminent Domain* (Cambridge, MA: Harvard University Press, 1985), 114.

[30] Fischel, "The Law and Economics of Cedar-Apple Rust," 172. It is part of the brilliance of Fischel's analysis that he shows in terms of the details of the enactment of the law and its subsequent enforcement that the moral hazard problem defeated the otherwise constitutionally required payment.

[31] The Virginia Cedar Rust Law, 1914 Va. Acts, p. 49 et seq., explicitly creates a fund paid for by taxes on apple growers to compensate the owners of especially valuable cedar trees. The relevant sections of the statute (sections 7 and 8) are reprinted in the Syllabus in *Bowman v. Virginia State Entomologist*, 128 Va. 351; 105 S.E. 141; 1920 Va.

interest in protecting it. All the growers of a pear, apple, orange, or peach, for example, have an interest in stopping the diseases that affect that fruit. It is advantageous for each to bear the risk that his or her trees might be destroyed if diseased rather than to have no power to force others to destroy their infected orchards. Statutes that require the destruction of infected fruit trees—including healthy trees that grow in the path of a pathogen and are reasonably certain to become infected—may be justified in terms of the "average reciprocity of advantage" of the fruit growers, since each one gains (at least ex ante) more from the prospective restrictions on others than he loses by accepting them himself.[32]

When a particularly virulent strain of citrus canker appeared in Florida in the late 1990s, that state enacted a statute that required the removal of all citrus trees within nineteen hundred feet of a tree infected with the bacterium. Florida courts have a lot of experience responding to aggrieved property owners whose trees, some of them still healthy, were cut by the state because they stood in the path of blight. Deciding a case in 1957, the Florida Supreme Court found that while diseased trees may have no value to be compensated, those that were still healthy, even if doomed by the spread of an infection, could still have a year or two to live and thus be worth something. Referring to Freund's treatise, the court held that it is "'a plain dictate of justice and of the principle of equality' that compensation be made for, at least, the loss of profits sustained by the owner whose healthy trees are destroyed."[33]

In a subsequent case, *Haire v. Florida Department of Agriculture and Consumer Services* (2004),[34] the Florida Supreme Court affirmed the constitutionality of the aforementioned statute requiring the removal of all citrus trees within nineteen hundred feet of a tree infected with citrus canker, a disease that devastated orange groves. The state program provided compensation of $55 or $100 for trees in residential areas (depending on when they were cut) if they were still healthy but were within range of the disease. Those with residential trees could petition for more compensation after a hearing. The program provided very little compensation for trees grown commercially, even if the trees were still overtly healthy, possibly because the program principally benefited the commercial industry.

Like many householders in Florida, Patty and Jack Haire, retirees living in suburban Broward County, grew in their yard orange trees that were of significant value to them. The Haires challenged a state agency determination to cut their trees. The *Haire* court, like the *Miller* court, found that the state could constitutionally require the destruction of one kind of property to protect another so important that it constituted a "public

[32] The doctrine of average reciprocity of advantage was first stated by Justice Oliver Wendell Holmes in *Pennsylvania Coal Co. v. Mahon*, 260 U.S. 393, 415 (1922).

[33] *Corneal v. State Plant Board*, 95 So. 2d 1, 6–7 (Fla. 1957).

[34] *Haire v. Florida Department of Agriculture and Consumer Services*, 870 So. 2d 774, 782 (Fla. 2004).

interest." The *Haire* court found "no basis for concluding that the eradication of citrus canker is not a legitimate use of the State's police power" in view of the importance of the citrus industry to the economy of Florida.[35]

What about compensation? There is nothing intrinsically wrong, antisocial, vicious, or even unneighborly about having an orange or lemon tree in one's yard. In the absence of a nuisance, to repeat Freund's dictum, "Where property is destroyed in order to save property of a greater value, a provision for indemnity is a plain dictate of justice and of the principle of equality." Even if the principle is clear, however, the amount of indemnity is often hard to determine. On the one hand, one could argue that citrus trees in the path of the canker are doomed and thus worth very little. This approach compares the destruction of healthy citrus trees within a nineteen-hundred-foot radius of an infected tree with the destruction of houses in the path of a conflagration. Compensation need not be paid because the house (or the tree) would be destroyed anyway.[36] On the other hand, the trees might live a year or two and be worth something. The *Haire* court stated, "[T]he fact that the Legislature has determined that all citrus trees within 1900 feet of an infected tree must be destroyed does not necessarily support a finding that healthy, but exposed, residential citrus trees have no value."[37]

The legislature in Virginia that enacted the Cedar Rust Law of 1914 and the legislature in Florida that enacted the Citrus Canker Law of 2004 understood that the property owners whose trees had to be destroyed did not act in a subnormal or antisocial way; their trees acted as passive conduits of harm to the more valuable trees owned by their neighbors but did not themselves cause a trespass. The landowners therefore were owed some compensation at least in principle because their trees were destroyed to save the trees owned by others, trees that had greater economic value (so great, indeed, that they constituted a public interest). In view of the plain dictate of justice, the laws made the state responsible for removing the trees and cleaning up and, in the Virginia program, stacking the wood. No one contended or could contend that the presence of infected cedar or citrus trees on one's property constituted a nuisance that made the owners responsible for removing the trees or for paying for their removal.

Commentators on this history of agricultural law may cite Justice Antonin Scalia's opinion for the majority in *Lucas v. South Carolina Coastal Council* (1992) to establish that just because a state agency or legislature declares something to be a nuisance does not automatically make it so.[38] Scalia found that when a state determines something to be a nuisance, it must

[35] See *Haire,* 870 So. 2d 774 at 781, 783; and *Miller,* 276 U.S. at 279–80.
[36] *Bowditch v. Boston,* 101 U.S. 16, 18 (1880).
[37] See *Haire,* 870 So. 2d 774 at 785.
[38] *Lucas* required that "South Carolina . . . do more than proffer the legislature's declaration that the uses Lucas desires are inconsistent with the public interest, or the conclusory assertion that they violate a common-law maxim such as sic utere tuo ut alienum non laedas." *Lucas v. South Carolina Coastal Council,* 505 U.S. 1003, 1031 (1992).

ground its judgment on "background principles" of property law: for example, common expectations about how people ought to behave. Plainly, to allow cedar or citrus trees on one's property is not to create a nuisance in the sense of "harm" that would permit the state even for the sake of a legitimate public interest to take the trees without paying compensation. If compensation is partial, the reason must be found in the circumstances, for example, the moral hazard that defeated Miller's claim or the disease that devalued Haire's trees. As Fischel points out, "in the ordinary nuisance case there is a more or less obvious 'subnormal behavior,' . . . a condition that ordinary people, *without the aid of the law,* can look at (or smell or listen to) and say, that party is not behaving as he ought to, at least at that place and time."[39]

If one uses one's land according to normal community standards—according to the background principles or expectations of common law—one may not be forced to alter it for a public good without being paid just compensation. Is the eradication of a non-native species, such as Japanese honeysuckle or phragmites, a public good sufficient to warrant legislation? Does the presence of such a plant on a person's land represent behavior that is "subnormal" or reprehensible enough to permit the state to destroy it without paying compensation and to force the landowner (as the ELI model law suggests) to bear all the costs?

V. Scientific Reproof

Conservation biologists, ecologists, and other environmental scientists argue that non-native species constitute a kind of "pollution" that degrades, destroys, and disrupts ecosystems.[40] Ordinary people—*without the aid of science*—may not be able to see this. "To the untrained eye, Everglades National Park and nearby protected areas in Florida appear wild and natural," two ecologists have written. Yet "foreign plant and animal species are rapidly degrading these unique ecosystems."[41] Ecologist Daniel Simberloff explains that while the impact of nonindigenous species "on the biotic community can be astounding, to the casual observer of nature they may not seem to be a major threat." As he notes, "a plethora of introduced animals may still represent nature to the average city dweller."[42] No matter how species-rich, beautiful, and complex an ecosystem may appear to the average city dweller, the biologist will see it as degraded

[39] Fischel, "The Law and Economics of Cedar-Apple Rust," 146. Fischel cites Robert C. Ellickson, "Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls," *University of Chicago Law Review* 40 (1973): 730.

[40] For a collection of papers to this effect, see B. N. McKnight, ed., *Biological Pollution: The Control and Impact of Invasive Exotic Species* (Indianapolis: Indiana Academy of Sciences, 1993).

[41] Don C. Schmitz and Daniel Simberloff, "Biological Invasions: A Growing Threat," *Issues in Science and Technology* Online, Summer 1997, http://findarticles.com/p/articles/mi_qa3622/is_199707/ai_n8780169.

[42] Daniel Simberloff, "The Biology of Invasions," in Daniel Simberloff, Don C. Schmitz, and Tom C. Brown, eds., *Strangers in Paradise: Impact and Management of Non-Indigenous Species in Florida* (Washington, DC, and Covelo, CA: Island Press, 1997), 3–17; quotation at 9.

insofar as alien species invade it. "The reasons why a particular invasion wreaks havoc depend on the interaction between the species and the habitat"—and this requires scientific judgment.[43] "All nonindigenous species are potentially harmful," ecologists have stated.[44]

The belief that non-native species threaten or harm ecosystems follows logically from a prevailing ecological theory that attributes the formation of ecosystems to the coevolution of species over millennia.[45] In an influential paper published in 1964, Paul Ehrlich and Peter Raven wrote that "studies of coevolution provide an excellent starting point for considering community evolution."[46] As a prominent ecologist has recently restated this thesis, "Large-scale patterns primarily result from, rather than drive, evolution at lower levels."[47] According to this view, by competition and coadaptation, species over millennia partition all possible niches and thus produce closed and stable communities. The goal of ecological science is then to discover, typically by mathematical modeling, the assembly rules that structure or govern ecosystems.[48]

The theory that evolutionary processes structure ecosystems and endow them with a mathematical organization (e.g., rule-governed patterns that ecologists can study) has the following implication. If invasive species enter and "meltdown,"[49] "harm,"[50] "disrupt,"[51] "destroy," and

[43] Daniel Simberloff, Ingrid M. Parker, and Phyllis N. Windle, "Introduced Species, Policy, Management, and Future Research Needs," *Frontiers in Ecology and the Environment* 3, no. 1 (February 2005): 12–20; quotation at 14. See also Daniel Simberloff, "Non-Native Species *Do* Threaten the Natural Environment," *Journal of Agricultural and Environmental Ethics* 18 (2005): 595–607.

[44] Daniel Simberloff, D. C. Schmitz, and T. C. Brown, "Why Should We Care and What Should We Do?" in Simberloff, Schmitz, and Brown, eds., *Strangers in Paradise,* 359–67; quotation at 364. According to Simberloff, "many scientists argue that every species should be considered a potential threat to biodiversity and sustainability if it were to be introduced. . . . That implies that every species proposed for deliberate introduction, whether or not it appears superficially to be innocuous, necessitates some formal risk assessment." Daniel Simberloff, "Nonindigenous Species—A Global Threat to Biodiversity and Stability," in Peter H. Raven and T. Williams, eds., *Nature and Human Society: The Quest for a Sustainable World* (Washington, DC: National Research Council, 1997), 329.

[45] The theory that species coevolve to form ecosystems—fragile communities of highly specialized interrelated organisms—produced the metaphors of conservation biology that analogized ecological communities to delicate machines. Paul Ehrlich analogized species to "rivets" holding up the wing on an airplane. See Paul Ehrlich and Anne Ehrlich, *Extinction: Causes and Consequences of the Extinction of Species* (New York: Random House, 1981). Writing in the same a priori tradition, Simon Levin updated the metaphor to that of a computer. According to Levin, ecosystems constitute "complex adaptive systems assembled from sets of available components as one would assemble a new computer system." Simon A. Levin, *Fragile Dominion: Complexity and the Commons* (Reading, MA: Perseus Books, 1999), 101.

[46] Paul R. Ehrlich and Peter H. Raven, "Butterflies and Plants: A Study in Conservation," *Evolution* 18 (1964): 586–608; quotation at 605.

[47] Levin, *Fragile Dominion,* 104.

[48] This is the "niche assembly perspective" extensively examined in S. P. Hubbell, *The Unified Neutral Theory of Biodiversity and Biogeography* (Princeton, NJ: Princeton University Press, 2001).

[49] Daniel Simberloff and Betsy Von Holle, "Positive Interactions of Nonindigenous Species: Invasional Meltdown?" *Biological Invasions* 1, no. 1 (1999): 21–32.

[50] David W. Ehrenfeld, "Adulusian Bog Hounds," *Orion* (Autumn 1999): 9–11.

[51] Raven and Williams, eds., *Nature and Human Society,* 325.

"degrade"[52] natural ecosystems, scientists should be able to tell by observation whether a given ecosystem is heavily invaded or remains in mint condition. Heavily invaded systems, being disrupted, will not exhibit the mathematical patterns or exemplify the orderly processes that characterize heirloom ecosystems. In the heirloom ecosystem, species will play by the rules that over time fashion biotic communities. In the invaded ecosystem, in contrast, species have come from all directions and play catch-as-catch-can. The site of an invaded ecosystem will be poorly organized, disrupted, damaged, and dissolute. These differences should be obvious to the ecologist who could then tell by inspection—not just by historical research—which places are pristine, properly functioning ecosystems and which are reprobate. Ecologists should be able to determine which organisms are native and which are carpet-baggers from the biology and behavior of those species.

In fact, once non-native species have become established, which may take only a short time, ecologists are unable by observing a system to tell whether or not a given site has been heavily invaded. Invaded and heirloom ecosystems do not differ in pattern or process, structure or function, in any general ways. Heirloom and invaded ecosystems function in the same ways. Nothing about the biological characteristics or behavior of a species, moreover, indicates that it is native or non-native (however that difference may be defined) or how long it has been at a site.[53] The field biologist who learns the history of particular places—not the armchair biologist who deduces the consequences of theoretical models—can tell which sites are invaded and which are still pristine.[54] Only by doing historical research—by determining what was there before—can the ecologist tell whether and by which species a site has been invaded.[55]

Several ecologists recognize that "it is important to ask whether species assemblages with novel combinations of species (including both native and exotic species) function in the same way as native assemblages, even when many of the constituent species do not have a shared evolutionary

[52] Schmitz and Simberloff, "Biological Invasions."

[53] For discussion, see, for example, K. Thompson, J. G. Hodgson, and T. C. G. Rich, "Native and Alien Invasive Plants: More of the Same?" *Ecogeography* 18 (1995): 390–402; B. J. Goodwin, A. J. McAllister, and L. Fahrig, "Predicting Invasiveness of Plant Species Based on Biological Information," *Conservation Biology* 13 (1999): 422–26; and M. Williamson, *Biological Invasions* (London: Chapman and Hall, 1996).

[54] In 1985, Dan Janzen, an empirical biologist, observed that species that do not share an evolutionary history may nevertheless fit together into normal ecosystems. D. H. Janzen, "On Ecological Fitting," *Oikos* 45 (1985): 308–10. For an example of a lush rainforest ecosystem composed entirely of introduced species, see D. M. Wilkinson, "The Parable of Green Mountain: Ascension Island, Ecosystem Construction, and Ecological Fitting," *Journal of Biogeography* 31 (2004): 1–4.

[55] This point is generally conceded. See, for example, M. A. Davis and K. Thompson, "Invasion Terminology: Should Ecologists Define Their Terms Differently Than Others? No, Not If We Want to Be Any Help!" *ESA Bulletin* 82 (2001): 206: "In the United Kingdom, about equal numbers of native and alien plants are expanding their ranges, and an analysis of their traits shows that these two groups are effectively indistinguishable."

history."[56] The inability of ecologists to tell (except by doing historical research) whether an ecosystem is invaded or pristine suggests an answer. Novel and native assemblages of species must function in the same way; otherwise, ecologists who do not know the historical record could distinguish between them. If they function the same way, then non-native species do not disrupt, degrade, or destroy the structure, pattern, or organization of ecosystems.[57]

If the heavily invaded system is just a hodgepodge of activity, so must be the pristine system, if one cannot observe general differences in the ways the two function. According to ecologist Peter Vitousek and his coauthors, invading species "do not just add players to the game, they change its rules—often to the benefit of that and other invaders."[58] If colonizing species can change the rules, in what sense could there have been *rules* at all? Perhaps one should characterize any ecosystem as a Heraclitean flux in such constant revision that no ecologist can observe the same biological community twice.[59] Ecosystems are not orderly. "I think that the natural world out there is more like a swirling and boiling cauldron," Mark Davis, an ecologist, has said.[60]

According to prevailing ecological theory, natural ecosystems self-assemble or evolve to possess an enduring structure: they obey rules, exhibit patterns, or follow principles.[61] This functional organization, if it existed, must distinguish heirloom systems from Johnny-come-lately hodgepodges of non-native species. No general difference, however, is observed. A hodgepodge appears to be as rule-governed as an heirloom—which is not rule-governed at all. Alien species, whether or not they threaten the natural environment, *do* threaten the theory of the natural

[56] D. F. Sax, J. J. Stachowicz, J. H. Brown, et al., "Ecological and Evolutionary Insights from Species Invasions," *Trends in Ecology and Evolution* 22, no. 9 (July 2007): 465–71; quotation at 468.

[57] For discussion, see Richard J. Hobbs, Salvatore Arico, James Aronson, et al., "Novel Ecosystems: Theoretical and Management Aspects of the New Ecological World Order," *Global Ecology and Biogeography* 15, no. 1 (2006).

[58] P. M. Vitousek, L. L. Loope, and C. M. D'Antonio, "Biological Invasion as a Global Change," in Richard Somerville and Catherine Gautier, eds., *Elements of Change* (Aspen, CO: Aspen Global Change Institute): 216–27.

[59] For discussion, see Kurt Jax, Clive G. Jones, and Steward T. A. Pickett, "The Self-Identity of Ecological Units," *Oikos* 82 (1998): 253–64. The concept of the natural world as flux and ecosystems as ephemeral became prominent in the 1990s, when disturbance rather than permanence became the leading metaphor. In reviewing these developments, environmental historian Donald Worster described the emerging view of nature as "a landscape of patches . . . a patchwork quilt of living things . . . responding to an unceasing barrage of perturbations. The stitches in that quilt never hold for long." Donald Worster, "The Ecology of Order and Chaos," in Char Miller and Hal Rothman, eds., *Out of the Woods: Essays in Environmental History* (Pittsburgh, PA: University of Pittsburgh Press, 1997), 10. See also Donald Worster, *Nature's Economy* (New York: Cambridge University Press, 1974, rev. ed. 1994).

[60] Quoted in Emma Marris, "Invasive Species: Shoot to Kill," *Nature* 438 (November 17, 2005): 272–73.

[61] For essays seeking to bolster this assumption, see Evan Weher and Paul Keddy, eds., *Ecological Assembly Rules: Perspectives, Advances, Retreats* (Cambridge: Cambridge University Press, 1999).

environment. Is it the ecosystem or a theory of the ecosystem that biologists seek to protect?

VI. Biodiversity

Before the 1990s, conservationists, ecologists, and other scientists generally held that species coevolved over millennia to partition niches (or allocate resources) to produce a structured and functioning community or system; this community, because its niches were filled, would resist the introduction of novel species.[62] According to the "biotic resistance" theory, as two ecologists summarize it, in pristine ecosystems "the biota is so saturated with plant and animal species that adding immigrating aliens causes the extinction of an equal number of native species—much like a game of musical chairs, where every player has to compete for a space in order to remain in the game."[63] As Simberloff has noted, "Until the recent burst of interest, conservationists were often complacent about nonindigenous species, assuming that disturbed habitats and communities are those most likely to be affected by these invasions whereas pristine areas are relatively immune."[64] Ecologists often rely on computer models that use random events or stochastic variation in relevant variables to project the likelihood of changes in a population or community. Ecologists John Stachowicz and David Tilman have written that the "stochastic model of community assembly predicts that, within a given habitat, increasing species richness should reduce resource availability and decrease invasion success."[65]

In the 1990s, however, conservationists warned that "[e]ven species-rich pristine habitats are threatened by non-indigenous species. . . ."[66] To explain this phenomenon, many biologists appealed to a leading

[62] R. H. MacArthur, "Species-Packing and Competitive Equilibrium for Many Species," *Theoretical Population Biology* 1 (1970): 1–11; R. H. MacArthur, *Geographical Ecology: Patterns in the Distribution of Species* (New York: Harper and Row, 1972).

[63] James H. Brown and Dov F. Sax, "Do Biological Invasions Decrease Biodiversity?" *Conservation Magazine* 8, no. 2 (April 2007).

[64] Simberloff, "Biology of Invasions," 3.

[65] John J. Stachowicz and David Tilman, "Species Invasions and the Relationships between Species Diversity, Community Saturation, and Ecosystem Functioning," in Dov F. Sax, John J. Stachowicz, and Steven D. Gaines, eds., *Species Invasions: Insights into Ecology, Evolution, and Biogeography* (Sunderland, MA: Sinauer, 2005), 41–64; quotation at 41. These authors state (ibid., 55): "If lower resource levels lead to more intense competition, and thence to greater competitive ability, it seems plausible that a region with more species would be both harder to invade and more likely to produce successful invaders." This a priori argument, which is representative of research in invasion biology, does not seem to match what is observed. According to Daniel Simberloff and Betsy Von Holle, the introduction of one exotic species often facilitates (rather than restricts) the introduction of others. "There is little evidence that interference among introduced species at levels currently observed significantly impedes further invasions, and synergistic interactions among invaders may well lead to accelerated impacts on native ecosystems—an invasional 'meltdown' process." Simberloff and Von Holle, "Positive Interactions of Nonindigenous Species," 21.

[66] Simberloff, "Biology of Invasions," 3–4.

ecological theory, *r/K* selection theory, which asserts that species respond to evolutionary pressures over time by adopting either a "generalist" strategy to occupy many empty niches (*r*-selection) or a "specialist" strategy to survive in or partition a contended niche (*K*-selection).[67] With ecological invasion, common or "weedy" species, on this view, will displace less common or endemic ones by using their resources; as a result, biodiversity—"the sum total of genetically based variation within and among species"[68]—must decrease. "The replacement of many losing species with a relatively small fraction of widespread winners will likely produce a much more spatially homogenized biosphere," ecologists predicted. "This implies that ecological homogenization might also occur because many ecological specialists are replaced by the same widespread and broadly adapted ecological generalists. . . . The ultimate degree of homogenization, if unchecked, will probably exceed even that seen in the largest past mass extinctions."[69]

What biologists observed, however, has been entirely different.[70] Organisms that appear specialized at one site may play new roles (for example, preying on different species) at new sites.[71] "This kind of flexibility allows well-functioning ecosystems to emerge even when the various member species do not share a long history of co-existence and mutual adaptation."[72] Accepted theory predicted "biotic resistance" and then mass extinction. Ecologists observed, on the contrary, that non-native species easily colonized rich ecosystems—there was little resistance—and those systems got richer. "Thus, there is an accelerating accumulation of introduced species and effects rather than a deceleration as envisioned in the biotic resistance model."[73]

[67] The theory was developed initially in Robert MacArthur and E. O. Wilson, *The Theory of Island Biogeography* (Princeton, NJ: Princeton University Press, 1967). It subsequently met with severe criticism. See, for example, S. C. Stearns, "Evolution of Life-History Traits—Critique of Theory and a Review of Data," *Annual Review of Ecology and Systematics* 8 (1977): 145–71.

[68] For this definition, see M. Vellend, L. J. Harmon, J. L. Lockwood, M. M. Mayfield, A. R. Hughes, J. P. Wares, and D. F. Sax, "Effects of Exotic Species on Evolutionary Diversification," *Trends in Ecology and Evolution* 22, no. 9 (2007): 481–88; quotation at 481.

[69] Michael L. McKinney and Julie L. Lockwood, "Biotic Homogenization: A Few Winners Replacing Many Losers in the Next Mass Extinction," *Trends in Ecology and Evolution* 14, no. 11 (1999): 450–53.

[70] "Thousands of species are doing quite well, thank you, in parts of the world where they did not evolve, a fact that alone provides the material for endless investigations. The editors and authors [of the book being reviewed] also note, summarizing earlier literature and contributing new information, that the general outcome of most invasions is to *increase* the overall pool of resident species." James T. Carlton, "Species Invasions: Insights into Ecology, Evolution, and Biogeography," *BioScience* 56, no. 8 (August 2006): 694–95 (reviewing Sax, Stachowicz, and Gaines, eds., *Species Invasions*).

[71] For discussion, see Geerat J. Vermeij, "Invasion as Expectation: A Historical Fact of Life," in Sax, Stachowicz, and Gaines, eds., *Species Invasions*, 315–39; esp. 326–31. Vermeij writes that "species play different roles in different places" (ibid., 329).

[72] Ibid., 329.

[73] Simberloff and Von Holle, "Positive Interactions of Nonindigenous Species," 22.

Biologists have found that invasions by exotic species "create almost ideal conditions for promoting evolutionary diversification."[74] Separated from their former populations, alien species diverge from them genetically, often in many ways, forming new kinds of populations.[75] Exotic species also hybridize with natives to produce novel lineages.[76] In response to pressure from exotic species, moreover, native species may evolve, drawing on intraspecific genetic variation and sometimes mutation, thus increasing their diversity.[77] For many reasons, "the net consequence of these invasions is generally an increase in total species richness."[78] New species emerge; homogenous populations diverge; biodiversity flourishes.

Exotic invaders generally increase the species richness of ecosystems, often dramatically. The Red Sea and the Mediterranean were separated for millions of years until the Suez Canal, which opened in 1869, brought them together. Researchers have found that "over 250 species, 34 new genera, and 13 new families have moved into the Mediterranean Sea from the Red Sea, yet there has only been one documented extinction."[79] In a similar story, the Chagres River on the Atlantic slope and the Rio Grande on the Pacific slope of Panama were isolated before 1914 when the Panama Canal joined them. Biologists have found the species richness of both rivers—surveyed in 1912 and in 2002—greatly increased. There were no extinctions.[80] Likewise, "in Hawaii freshwater fish richness has increased by 800% with the introduction of 40 exotic species and the loss of none of the five native species."[81] Researchers found in the San Francisco Estuary "a total of 234 exotic species established in the ecosystem," and at least 125 additional "cryptogenic" species, so called because of the absence of historical evidence of their provenance.[82] These researchers also found that "no introduction in the Estuary has unambiguously caused the extinction of a native species."[83] The "evidence for invasion-caused extinction

[74] Vellend et al., "Effects of Exotic Species," 481.

[75] This is "Allopatric speciation: the creation of new species via genetic divergence in geographically separated populations." Ibid.

[76] "[H]ybridization between individuals from genetically divergent native populations may result in introduced populations having more genetic variation than native populations of the same species." Fred Allendorf and Laura Lunquist, "Introduction: Population Biology, Evolution, and Control of Invasive Species," *Conservation Biology* 17, no. 1 (2003): 24–30; quotation at 24–25.

[77] J. A. Lau, "Evolutionary Responses of Native Plants to Novel Community Members," *Evolution* 60 (2006): 56–63.

[78] Sax et al., "Ecological and Evolutionary Insights," 466.

[79] H. A. Mooney and E. E. Cleland, "The Evolutionary Impact of Invasive Species," *Proceedings of the National Academy of Sciences of the United States* 98, no. 10 (2001): 5446.

[80] S. Smith, G. Bell, and E. Bermingham, "Cross-Cordillera Exchange Mediated by the Panama Canal Increased the Species Richness of Local Freshwater Fish Assemblages," *Proceedings of the Royal Society of London, Series B, Biological Sciences* 271, no. 1551 (2004): 1889–96.

[81] Sax et al., "Ecological and Evolutionary Insights," 467.

[82] Andrew Cohen and James Carlton, "Accelerating Invasion Rate in a Highly Invaded Estuary," *Science* 279, no. 5350 (January 23, 1998): 555–58.

[83] Andrew Cohen and James Carlton, *Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta. A Report for*

is weak or non-existent" with respect to "marine organisms, land plants, and smaller terrestrial animals,"[84] except in a few insular areas, such as a lake exposed to a predatory species.[85]

The situation is the same in terrestrial environments. According to two ecologists, "Within the last few centuries following European colonization, relatively few insular endemic plant species have become extinct, whereas invading species have approximately doubled the size of island floras—from 2,000 to 4,000 on New Zealand; 1,300 to 2,300 on Hawaii; 221 to 421 on Lord Howe Island, Australia; 50 to 111 on Easter Island; and 44 to 80 on Pitcairn Island."[86] Mark Davis has written that in the United States, which hosts thousands of non-native plants, "there is no evidence that even a single long-term resident species has been driven to extinction . . . because of competition from an introduced plant species."[87] With few exceptions, landscapes already rich in native species "support many more species of exotics than areas with relatively few native species."[88] Alien species make rich ecosystems richer. "It is apparent that there is no theoretical limit to the number of species in any community."[89]

VII. Executive Order 13112

In a 1997 letter to Vice President Al Gore, more than five hundred ecologists, conservation biologists, and other environmental professionals wrote, "A rapidly spreading invasion of exotic plants and animals . . . is destroying our nation's biological diversity" and called for "an effective national program to combat invasions by nonindigenous plants and ani-

the United States Fish and Wildlife Service (Washington, DC: The National Sea Grant College Program and the Connecticut Sea Grant Program, 1995), http://www.sgnis.org/publicat/cc1.htm.

[84] Vermeij, "Invasion as Expectation," 329.

[85] "Much of the evidence that introduced species cause extinction does not come from studies of introduced plants, but from those of introduced animals, generally predators, and plant diseases. Many of these studies involve animals on islands and, in particular, species of birds that have gone extinct following the introduction of a predatory species, such as the brown tree snake, *Boiga irregularis,* on Guam." Judith H. Myers and Dawn Bazely, *Ecology and Control of Introduced Plants* (Cambridge: Cambridge University Press, 2003), 16. The bird extinctions on Guam can hardly be said to have taken place in a "natural" area. The island was extensively bombed by the Allies during World War II. It was then extensively developed as a gargantuan shopping mall and recreation area for Japanese and other Asian consumers and tourists. For a study of the difficulty of finding a "natural area" on Guam, see Alan Burdick, *Out of Eden: An Odyssey of Ecological Invasion* (New York: Farrar, Straus, and Giroux, 2005).

[86] Brown and Sax, "Do Biological Invasions Decrease Biodiversity?"

[87] M. A. Davis, "Biotic Globalization: Does Competition from Introduced Species Threaten Biodiversity?" *BioScience* 53 (2003): 481–89.

[88] J. D. Fridley, J. J. Stachowicz, S. Naeem, et al., "The Invasion Paradox: Reconciling Pattern and Process in Species Invasions," *Ecology* 88 (2007): 3–17; quotation at 5–6.

[89] Paul D. Kilburn, "Analysis of the Species-Area Relation," *Ecology* 47, no. 5 (1966): 831–43; quotation at 842.

mals."[90] In response, in 1999 President Bill Clinton signed Executive Order 13112, "Invasive Species," which established the National Invasive Species Council (NISC) and instructed it to develop a management plan "for preventing the introduction and spread of invasive species" and to "provide for restoration of native species and habitat conditions" in invaded systems. The executive order defines a species as "alien" if it is "not native" to the ecosystem in which it is found. Since no way to define or delimit ecosystems exists, "native" is usually construed as present in the United States before the European settlement. The order defines a non-native or alien species as "invasive" if it causes or is likely to "cause economic or environmental harm or harm to human health."[91]

When people get sick or lose crops to disease, they know they have been harmed. People cannot know that non-native species cause "environmental harm," however, without the aid of science, particularly theoretical models of ecosystem structure and function. Scientists rather than ordinary people define "environmental harm" and prescribe ways to prevent and mitigate it. To maintain political clout—and the demand for their expertise—scientists must maintain a consensus about what causes "environmental harm" and about how great an evil it represents.

NISC has made its mission the prevention and mitigation of the "environmental harm" caused by alien species.[92] In response to questions about the meaning of "environmental harm," the Invasive Species Advisory Committee of NISC issued a white paper which states: "We use environmental harm to mean biologically significant decreases in native species populations." The paper adds: "Environmental harm also includes significant changes in ecological processes, sometimes across entire regions, which result in conditions that native species and even entire plant and animal communities cannot tolerate." This definition "will apply to *all taxa of invasive species in all habitats*" and therefore to private as well as public land.[93]

[90] For a description of this letter, see the National Invasive Species Council, National Management Plan, October 2001, *Meeting the Invasive Species Challenge*, p. 13; available online at http://www.invasivespeciesinfo.gov/docs/council/mp.pdf. The text of the letter is available at http://aquat1.ifas.ufl.edu/schlet2.html.

[91] Executive Order 13112, February 3, 1999, "Invasive Species," Federal Register: February 8, 1999 (volume 64, number 25); available online at http://www.invasivespeciesinfo.gov/laws/execorder.shtml.

[92] The management plan NISC published in 2001 states its view that "damage to natural areas is increasing in priority" relative to agriculture. National Invasive Species Council, National Management Plan, *Meeting the Invasive Species Challenge*, October 2001; quotation at p. 19. Of the roughly thirty-five invasive plants for which the Council has completed profiles, only about three are listed by USDA as noxious weeds in agriculture. For discussion and citation, see Justin Pidot, "Note: The Applicability of Nuisance Law to Invasive Plants: Can Common Law Liability Inspire Government Action?" *Virginia Environmental Law Journal* 24 (2005): 183–230; see especially p. 195.

[93] National Invasive Species Council (NISC), *Invasive Species Definition Clarification and Guidance*, White Paper submitted by the Definitions Subcommittee of the Invasive Species Advisory Committee (ISAC); approved by ISAC, April 27, 2006. Published online at http://www.invasivespeciesinfo.gov/docs/council/isacdef.pdf. Quotation at p. 5.

In documents coordinating state and federal programs, NISC supports the use of biological controls—"natural enemies" including fungal infections, pathogens, and predatory beetles—to battle invasive species. The predator or pathogen intended to destroy a non-native plant, such as honeysuckle, English ivy, or purple loosestrife, even if initially released on public land, may well migrate to attack plants that a landowner may cultivate or otherwise value. What then? If a landowner objects, the federal or state agency must identify how the public interest is served by the eradication of what seem to be—and often are—ornamental plants that landowners enjoy and which, they may argue, do not harm but enhance the value of their property.

A state or federal agency could reasonably reply that the public interest, at least in certain places, favors native over non-native species and communities for antiquarian reasons. Just as Greece preserves the Acropolis and other ruins, Rome maintains the Coliseum, and other nations protect the remnants of their cultural heritage—which, incidentally, may turn out to be terrific tourist attractions—so, too, the United States has an aesthetic, ethical, and historical duty and opportunity to maintain as well as it can the vestiges of its past (for example, in parks like Yosemite and Yellowstone). To maintain living museums of natural history, curatorial agencies such as the National Park Service may engage in gardening on a grand scale, fighting the forces of nature (in this context, invasive species) that constantly wear down the monuments of the past. Agencies prune the past of the present at particular sites to preserve a venerable national or local heritage.

Another aesthetic argument points to the iconic value of certain species—for example, trees such as the chestnut, ash, and elm—which may be threatened by invasive pathogens. The "environmental harm" these pathogens cause—and the reason the Animal and Plant Health Inspection Service has the mandate to battle them—lies in the aesthetic significance of these trees in the landscape. The aesthetic value of these historic trees may be immeasurable, but the ecosystem will go on with or without them. "Even a mighty dominant like the American chestnut, extending over half a continent, all but disappeared without bringing the eastern deciduous forest down with it," David Ehrenfeld has written.[94]

Beside aesthetic considerations, why is native better? Scientists know that non-native species often provide an enormous stimulus to biological diversification. "Through genetic engineering, species introduction, and environmental modification, we conceivably could manufacture a world even more biologically variable and 'diverse' than the one derived through evolutionary processes," Paul Angermeier has written.[95] Nevertheless,

[94] David Ehrenfeld, "Why Put a Value on Biodiversity?" in *Biodiversity,* ed. E. O. Wilson (Washington, DC: National Academy Press, 1988), 212–16.

[95] Paul Angermeier, "Does Biodiversity Include Artificial Diversity?" *Conservation Biology* 8, no. 2 (1994): 600–602.

ecologists generally rule out the possibility that alien species could add to biodiversity. "Our definition [of biodiversity] excludes exotic organisms that have been introduced," a group of biologists has stated.[96] Once the concept *native* is implied in the concept *biodiversity,* observational evidence becomes irrelevant; historical research is all that matters in comparing levels of "biodiversity."

To see why, suppose that an ecologist observes on one island a hundred trillion species in a fantastically intricate ecosystem, and on another island only one species, say, of lichen clinging to rocks. Whichever island has the most "native" species has the most biodiversity; thus, the island with the native lichen can be more diverse than the island with a hundred trillion "introduced" species. The history—not the biology—is all that matters once "biodiversity" is limited to "native" species, whatever that term may mean. The thesis that exotic species diminish "biodiversity" depends not on biological observation but on logical inference "when 'native' is implied but omitted as a modifier of 'biodiversity.' "[97]

NISC speaks of protecting and restoring "the original ecosystem,"[98] but it is unclear why it believes an original ecosystem is generally better than an updated one. A creationist may answer that God designed the original ecosystem and therefore species should stay near where Noah dropped them off. Executive Order 13112 defines a species as "native" if it occurs in an area other than by "introduction," that is, other than with human assistance. This connects the "original ecosystem" with original sin—the idea that if a species travels not by its own powers but in the wake of human activity, it is alien or exotic and thus corrupt. Daniel Simberloff points out that the quality invasive species share is their association with human beings. "The one thing for sure is that all of these species arrived with human assistance in little more than a century, and almost certainly none would have reached there in a million years on its own."[99]

If one does not share the doctrine of some Christians that humanity, because of the fall from grace, corrupts innocent nature, or the belief of some creationists that the world came into existence only a few thousand years ago, there is no nonarbitrary way to tell what is "original" and what is not. According to conservation biologist Michael Soulé, "any serious attempt to define the original state of a community or ecosystem leads to a logical and scientific maze."[100]

[96] Osvaldo E. Sala, F. Stuart Chapin III, Juan J. Armesto, et al., "Global Biodiversity Scenarios for the Year 2100," *Science* 287 (March 10, 2000): 1770–74.

[97] Simberloff, "Non-Native Species *Do* Threaten the Natural Environment," 603.

[98] National Invasive Species Council, National Management Plan, *Meeting the Invasive Species Challenge,* 10, 12.

[99] Simberloff, "Non-Native Species *Do* Threaten the Natural Environment," 598–99.

[100] Michael Soulé, "The Social Siege of Nature," in M. Soulé and G. Lease, eds., *Reinventing Nature: Responses to Postmodern Deconstruction* (Washington, DC: Island Press, 1995), 137–70; quotation at 143.

To defend the superiority of the "original" ecosystem, biologists do not refer to scripture but to mathematical and theoretical constructs. They develop stochastic models of community assembly, matrices of interaction coefficients, interspecific trade-off curves, theories of self-organized criticality, languages of ecosystem ontogeny, hierarchical path-dependent complex dynamical computational representations with multiple basins of attraction, the logic of regime shifts, synergetic effects, state-and-transition flips, and many other mathematical marvels, in order to infer the pattern, process, structure, or function that distinguishes an original heirloom ecosystem from an invaded and thus corrupted one. All this is accomplished *in silico* rather than *al fresco,* that is, in front of the computer rather than in the great outdoors.

VIII. Epistemic Communities

"An epistemic community," as political scientist Peter Haas has characterized it, "is a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area."[101] As Haas and others have shown, ecologists and environmental scientists with influence in governmental agencies have played a crucial and creative role in solving environmental problems: for example, in controlling sewage and other pollutants to save the Mediterranean Sea, and in banning the use of chlorofluorocarbons to protect the stratospheric ozone layer.[102]

Epistemic communities, according to Haas, possess "a shared set of normative and principled beliefs, which provide a value-based rationale for the social action of community members." They also share causal beliefs along with "internally defined criteria for weighing and validating knowledge in the domain of their expertise." They have reached a consensus about science and policy, and they seek to bring those with political power into that consensus.[103]

Biologists who study invasive species—invasion biologists—constitute an epistemic community. On the basis of the theory of island biogeography (the "musical chairs" analogy discussed above), *r/K* selection theory, biotic resistance theory, models of community self-assembly, and other

[101] Peter M. Haas, "Introduction: Epistemic Communities and International Policy Coordination," *International Organisation* 46, no. 1 (1992): 1–36; quotation at 3.

[102] Peter M. Haas, *Saving the Mediterranean—The Politics of International Environmental Co-operation* (New York: Columbia University Press, 1990); Peter Haas, "Banning Chlorofluorocarbons: Epistemic Community Efforts to Protect Stratospheric Ozone," *International Organizations* 46, no. 1 (1992): 187–224. See also Peter Haas, "Obtaining International Environmental Protection Through Epistemic Consensus," in Ian Rowlands and Malory Greene, eds., *Global Environmental Change and International Relations* (London: Macmillan, 1992); and Peter Haas, "Social Constructivism and the Evolution of Multilateral Governance," in Jeffrey Hart and Aseem Prakash, eds., *Globalization and Governance* (London: Routledge, 1999).

[103] Haas, "Introduction: Epistemic Communities and International Policy Coordination," 3.

mathematical constructs, an overwhelming majority of invasion biologists have concluded that the influx of non-native species (NNS) will cause biodiversity greatly to decline. The "overwhelming consensus of ecologists and systematic specialists who study them is that NNS are a highly significant factor in endangerment and extinction—indeed second only to habitat destruction by most tallies." [104] Power should follow knowledge. Conservation biologist Thomas Lovejoy has said that scientists "must take on an advocacy role" for the environment because "scientists understand best what is happening and what alternatives exist." [105]

Invasion biologists agree that alien species threaten the natural environment. They "speak truth to power" in the name of that consensus. They have proposed regulations that would establish "clean lists" of those non-native species that are permitted in the United States. Those who wish to introduce a species not on the "clean list" must prove that it would not harm the environment. In spite of the scientific consensus that supports "clean list" proposals, they are rarely mandated. These proposals "met with strong opposition from agriculture, the pet trade, and other special interest groups," according to Don Schmitz and Daniel Simberloff. "Because of the political power of vested interests, federal and most state agencies . . . do not demand that importers of plants and animals demonstrate that an introduction will prove innocuous." [106]

Invasion biologists and other ecologists are generally united in their belief about the threat that alien species pose to biodiversity—as the 1997 letter by five hundred experts to then Vice President Gore suggests.[107] Having reached a consensus and gained influence as an epistemic community, invasion biologists have met with outstanding success in obtaining public support for their research. Yet they have not seen their policy recommendations followed.[108] Why is it that epistemic communities of

[104] Simberloff, "Non-Native Species *Do* Harm the Natural Environment," 597. For a principal paper supporting this consensus, see D. S. Wilcove, D. Rothstein, J. Dubow, A. Phillips, and E. Losos, "Quantifying Threats to Imperiled Species in the United States," *BioScience* 48 (1988), 607–15. For a critique of this paper, see Mark Sagoff, "Do Non-Native Species Threaten the Natural Environment?" *Journal of Agricultural and Environmental Ethics* 18 (2005): 215–36.

[105] Thomas Lovejoy, "The Obligations of a Biologist," *Conservation Biology* 3, no. 4 (1989): 329–330; quotation at 330.

[106] Schmitz and Simberloff, "Biological Invasions."

[107] See note 90 above. Simberloff accurately describes those who disagree with the consensus within invasion biology as comprising primarily nonscientists and a few unreconstructed ecologists. Simberloff identifies "a number of authors from different cultural fields, who have joined with a few ecologists in a rearguard action to convince biologists and the lay public that the ecological threat from introduced species is overblown" (parenthetical citations omitted). Daniel Simberloff, "Invasional Meltdown Six Years Later: Important Phenomenon, Unfortunate Metaphor, or Both?" *Ecology Letters* 9, no. 8 (August 2006): 912–19; quotation at 915.

[108] Public agencies have attempted to make the monitoring and control (these are different things) of invasive species such as purple loosestrife and Eurasian water-milfoil conditions for obtaining licenses or permits. For an appreciation of the intricacies involved, see, for example, *Rhinelander Paper Co. v. FERC,* 405 F.3d 1 (D.C. Cir. 2005) (upholding a ruling by the Federal Energy Regulatory Commission that required the petitioner, the operator of

ecologists and other scientists were successful in saving the Mediterranean and protecting the ozone layer, but have not succeeded in stemming the tide of non-native species?

In supporting the Mediterranean Action Plan, marine ecologists pointed to sewage washing up on beaches from the Riviera to Israel to North Africa. Everyone understands that sewage stinks. Similarly, in supporting the Montreal Protocol, atmospheric scientists related the thinning ozone level to the increasing incidence of skin cancer. When scientists link a condition or a practice (smoking, for example) with cancer, they are likely to get the regulations they seek. The public understands what "harm" is when it shows up as cancer, unsanitary water, or unbreathable air.

Invasion biologists describe non-native species as ecological pollution.[109] Japanese honeysuckle, purple loosestrife, and multiflora rose, however, do not look or smell like sewage; in fact, just the reverse. Biologists may call these plants pollutants, but this does not make them pollutants. Invasion biologists invoke metaphors of disease, describing invasive species as overcoming "biotic resistance" to spread aggressively like cancer. Yet invaded ecosystems do not seem to be "dying." The public understands that pathogens, whether native or not, harm human health; it understands that plant pests, such as the emerald ash borer, destroy iconic trees. That pathogens and pests may harm human health and economic interests, however, does not explain what scientists mean by "harm to the natural environment." West Nile disease has nothing to do with purple loosestrife; in battling one, why must society also detest the other?

In describing successful epistemic communities, Peter Haas has written, "Common principles and norms gave rise to a common set of rules for pollution control."[110] Invasion biologists demonstrate deductively that non-native species threaten biodiversity because these scientists define "biodiversity" to include only native species. They have been unable, however, to link this narrow definition of biodiversity with any normative concept that people can understand without the aid of science. Invasion biologists assume that native is better, but they do not explain why. They have failed to connect their interests as scientists with the public interest.

IX. Conclusion

"The whole aim of practical politics is to keep the populace alarmed (and hence clamorous to be led to safety) by menacing it with an endless

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a hydroelectric dam, as a condition of continuing its operating license, to develop and implement a plan to monitor purple loosestrife and Eurasian water-milfoil at the project site).

[109] B. N. McKnight, *Biological Pollution: The Control and Impact of Invasive Exotic Species* (Indianapolis: Indiana Academy of Science, 1993).

[110] Haas, "Epistemic Communities and International Policy Coordination," 3.

series of hobgoblins, all of them imaginary."[111] The thinning ozone layer was not imaginary. Effluents and emissions controlled by the Clean Air Act and the Clean Water Act in the United States and by the Mediterranean Action Plan were not imaginary. People know, first, that air and water pollution cause real damage and, second, that no one has a right to inflict that kind of damage on others. Scientists in the 1970s who helped write pollution control policy did not prescribe values for society. They responded to health-and-safety considerations—values society already had.

Environmental policy, when it depends on background principles of common law, may justify the regulation of one person's property to protect the person or property of his or her neighbors. As the statutes and cases in agricultural law discussed earlier suggest, state officials may even enter private land to destroy the trees, plants, or other property of a landowner to protect an industry of such great economic importance that it constitutes a public interest. This can be justified, however, only when the expense is borne by the public and just compensation is paid. The public interest is not to be confused with the interest of an epistemic community, however united it may be in raising an alarm and calling for power and money to answer it.

In recent years, ecologists, conservation biologists, and other environmental professionals have developed as societal goals normative concepts that do not resonate in common law but originate in their own research. These normative concepts include "ecological integrity," "invasive species," "biodiversity," "ecosystem services," and "sustainability." How should society respond to these research-originated and science-driven norms and goals? Having no basis in common law, normative concepts such as these are malleable to the political and cultural commitments of those who make them the objects of their professional study. If teams of social scientists and biologists agree, however, about what is needed to sustain ecosystems, protect biodiversity, and save the environment from harm, how can society not heed their advice?

Invasion biologists, ecological economists, conservation biologists, and other scientists constitute a large and important epistemic community that argues that the current ecological crisis is so alarming and menacing that society can no longer limit the use of the police power to protect people from the environment (e.g., from hazardous substances, pollutants, pathogens, and pests) but must move swiftly and effectively to protect the environment from people. That scientists can define environmental harm is the assumption that underlies the recommendations of NISC and the model state laws developed by the Environmental Law Institute. On this view, scientific research determines what harms the

[111] H. L. Mencken, *Mencken Chrestomathy: His Own Selection of His Choicest Writing* (New York: Vintage, 1982), 29.

environment; legislatures and courts may then require that society respect "ecological integrity," protect the "biotic community," preserve "biodiversity," exclude and eliminate "invasive species," and promote "sustainability." Society does not have the leisure, however, to wait for scientists to define these concepts perfectly; rather, scientists can reach a working consensus on many goals and then direct society to achieve them.

What does one say in response to the model legislation ELI proposed to help states rid public and private land of invasive species?[112] Following the lead of conservation biologist Thomas Lovejoy, one might declare that scientists "understand best what is happening and what alternatives exist." As long as teams of scientists are interdisciplinary, they may claim to be representative. Nevertheless, a nagging doubt—something in the spirit of democracy—may lead one to ask, "Who do these people think they are?"

The police power has been used for centuries to protect people from sources of injury and harm. The identification and measurement of *injury* and *harm,* moreover, have always been understood within legal processes and constitutional constraints. In the context of environmental law in the United States, the police power protects people from the environment. It protects people from toxic and hazardous substances—including pathogens and pests—that move through the earth, water, and air. Conservation biologists, ecologists, and other environmental professionals, in contrast, propose the environment itself—labeled as the "biotic community," the "ecosystem," or "biodiversity"—as an object of protection. To be sure, these experts may refer to traditional goals or goods (e.g., to human health and to agriculture), but it is the sustainability and integrity of the native biotic community that interests them. They seek to protect the environment from people—and this has no basis in the police power or in the law of nuisance.

Environmental statutes in the United States since 1969 have rested largely on the legal foundation of the common law of nuisance. The many successes of environmental regulation have been won primarily by policies that controlled the gross emissions of industrial and municipal polluters and by policies that reduced less visible and often unquantifiable risks, for example, from small amounts of carcinogenic substances. Another wave of environmental legislation responds to aesthetic, historical, cultural, and spiritual values concerning wilderness areas, iconic landscapes, and rare and wonderful plants and animals. The preservation of species, the protection of wild and scenic places, and other aesthetic and aspirational goals soon came to be litigated and thus tested in terms of distributional problems, that is, problems of footing the bill. These problems, for example, in the development of habitat conservation plans for endangered

[112] For an example of an attempt at applying the rule that makes property owners responsible for policing invasive species, see, for example, Richard Moore, "Invasives Rule Would Allow DNR to Enter Private Property; Legislative Council Seeks Constitutional Justification," *Lakeland Times,* November 21, 2008, http://www.lakelandtimes.com/main.asp?SectionID=9&SubSectionID=9&ArticleID=8720.

species, came to be adjudicated largely on a case-by-case basis under established and familiar precedents in property, land-use, wildlife, and natural resources law.[113]

Do epistemic communities have the ability to forge by consensus novel conceptions of harm—for example, "environmental harm"—and, therefore, new categories of nuisance for the police power of the state to prevent? The Supreme Court has found that the natural environment per se lacks the kinds of rights or interests that the cold steel of the law protects. The environment—even if described in a normative way as an "ecological community"—is not a person. It does not sustain injuries or endure harms that give it (or the scientists who represent it) standing to sue for redress in the judicial system created by Article III of the Constitution. In environmental cases, "the relevant showing . . . is not injury to the environment but injury to the plaintiff." [114]

As traditionally interpreted, the takings clause of the Fifth Amendment requires that a public authority may enter onto a person's land and destroy his or her property only if this action serves a sufficiently compelling public interest and only if (in the absence of nuisance) compensation is paid. Just because a government says something is a nuisance does not make it one; rather, the nuisance exception to compensation refers to background principles of common law. The compensation test is often described as the way to assure efficiency in the context of takings jurisprudence. Even more important, an insistence that government pay all the costs, compensate a landowner, and clean up after itself is the way to assure liberty, that is, the right of every person to be left to live in peace as long as he or she respects the same right of others. The government, in the name of some good it constructs (or some evil it invents), may otherwise become the most virulent invader.

The principle that, absent a nuisance cognizable in common law, compensation must be paid when the government invades private property to promote a public interest might seem to express a technical crotchet of conservative judges. On the contrary, by denying epistemic communities the power to define harm and thus to make law, this principle is one of the most important defenses democracy possesses against the tyranny implicit in scientism.

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[113] As a result, environmental law has by now largely ceased to exist as a separate form of jurisprudence. See A. Dan Tarlock, "Is There a There There in Environmental Law?" *Journal of Land Use and Environmental Law* (Spring 2004): 214–52. Tarlock explains: "Environmental law, as now defined, is primarily a synthesis of pre–environmental era common law rules, principles from other areas of law, and post–environmental era statutes which are lightly influenced by the application of concepts derived from ecology and other areas of science, economics, and ethics" (ibid., 222).

[114] *Friends of the Earth, Inc. v. Laidlaw Environmental Services (TOC), Inc.,* 528 U.S. 167, 181 (2000).