THE BUTTERFLY EFFECT: CONSERVATION EASEMENTS, CLIMATE CHANGE, AND INVASIVE SPECIES

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Abstract: This Article explains that one of the consequences of climate change will be migrations of species from their native habitats to newer habitats, typically to the north, with climates similar to those in which such species evolved. These in-migrating species will in many cases be invasive, forcing the native species to out-migrate or be driven to extinction, thereby causing biodiversity loss. As many of these disrupted ecosystems may be protected by perpetual conservation easements, the Article discusses the negative legal consequences of incursions by non-native species on these existing conservation easements. Accordingly, the Article suggests a number of changes that can be made to future conservation easements to help insure their protection of land in perpetuity and to better protect species and their habitats from the effects of climate-change-caused migrations.

Introduction: A Sound of Thunder

The 1952 science fiction short story *A Sound of Thunder* by author Ray Bradbury is one of the most republished science fiction stories of all time.[1] In the story, set in the year 2055, a big game hunter named Eckels hires a time machine company to take him back in time to kill the biggest game of all, a Tyrannosaurus Rex.[2] Once back in time, Eckels meets his intended prey.[3] However, Eckels is so frightened that he breaks the cardinal rule of time travel: he steps off the elevated pathway

 He received his J.D. at the University of California, Davis, School of Law. The author would like to thank John Chapman, Jessica Green, Nancy A. McLaughlin, Reed Noss, Jessica Owley Lippmann, and Adena Rissman for their generous and invaluable input. The author is especially grateful for the meticulous editing and unfailing encouragement of the *Boston College Environmental Affairs Law Review* staff.

[1] William G. Contento, *Index to Science Fiction Anthologies and Collections, Combined Edition*, Galactic Cent., http://www.philsp.com/homeville/isfac/0start.htm (last updated Jan. 26, 2008).

[2] Ray Bradbury, *A Sound of Thunder*, *in* The Stories of Ray Bradbury 231, 231–32 (3rd prtg. 1981).

[3] *Id.* at 236.

designed to prevent time travelers from the future from contacting the soil or its plants and thereby changing history.[4] After returning to 2055, Eckels notices that many things are different.[5] Most notably, the liberal political regime that was in place when he left has been replaced by a fascist government.[6] The cause of the changes is eventually discovered; on the sole of Eckels' boot is a single crushed butterfly.[7]

While many people are familiar with the story itself, many more people are familiar with the term "the butterfly effect."[8] In popular usage, the butterfly effect refers to the theory that a single small effect can multiply into an ever-increasing cascade of events, leading to a multitude of unpredictable consequences.[9] Although it is tempting to think of the butterfly effect as similar to a row of dominoes in which each domino knocks down the next, the comparison is not apt.[10] In the case of the dominoes it is easy to predict the order in which the dominoes will fall and what the ultimate outcome will be.[11] The butterfly effect, on the other hand, is unpredictable by any human means.[12] Indeed, the butterfly effect stands for the proposition that certain outcomes are so sensitive to their initial states that the resulting complexity defies human prediction.[13] Embedded in this complexity is the operation of feedback loops, exponential increases and decreases in system components, and irreversible tipping points.[14] In this sense, the butterfly effect is a powerful allegory of global climate change.

In *A Sound of Thunder*, the initial disturbance of history was the killing of a single butterfly.[15] In our climate-changing world, the butterfly

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[4] *Id.* at 233–34, 237.

[5] *Id.* at 240–41.

[6] *See id.* at 232, 241.

[7] *Id.* at 240.

[8] *See* Jake Tapper, *Barack Obama's Butterfly Effect*, ABC News (July 20, 2008, 4:45 PM), http://blogs.abcnews.com/politicalpunch/2008/07/barack-obamas-b.html; *see also* Robert C. Hilborn, *Sea Gulls, Butterflies, and Grasshoppers: A Brief History of the Butterfly Effect in Nonlinear Dynamics*, 72 Am. J. Physics 425, 425 (2004) (describing the history of the term "butterfly effect").

[9] *See* Hilborn, *supra* note 8, at 425; Tapper, *supra* note 8 (explaining how an unintended single word from the President can affect something as large as the Mideast peace process).

[10] *See* Hilborn, *supra* note 8, at 425.

[11] *See id.*

[12] *Id.*

[13] *See id.*

[14] *See* Robert Henson, The Rough Guide to Climate Change 16–17, 75 (Duncan Clark ed., 2006).

[15] *See* Bradbury, *supra* note 2, at 240.

is the emission of greenhouse gases[16] that contribute to global warming and climate change.[17] Indeed, almost every action we take results in more carbon dioxide being released into the atmosphere.[18] Activities as simple as driving a car to the store to buy groceries, or even turning on a single light bulb, discharge more carbon into the atmosphere.[19] What is worse, today it is not just one of us turning on the light bulb.[20] Every day about 6.9 billion of us,[21] in ways small and large, collectively discharge prodigious amounts of carbon and other greenhouse gases into the atmosphere.[22] The net result is global climate change.[23] If Eckels altered the course of millions of years of history by stepping on a single butterfly, what are we doing to planetary history by pumping ever more greenhouse gases into the atmosphere every second of every day? There is not one of us alive today who is not playing the role of Eckels.[24] In our reckless search for wealth and convenience we have wiped out entire species of butterflies and of many other creatures as well,[25]

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[16] There are a number of greenhouse gases (GHGs), each with its own sources, effects, and duration in the atmosphere. HENSON, *supra* note 14, at 23–27. Included among the GHGs are: carbon dioxide (CO_2), methane, ozone, water vapor, and the suite of chemicals collectively described as chlorofluorocarbons. *Id.* For purposes of this Article, carbon dioxide, simply referred to as carbon, serves as a proxy for all such GHGs. For a more in-depth explanation of the science of greenhouse gases, see, for example, *id.*; Andrew J. Waskey, *Carbon Dioxide*, *in* 1 ENCYCLOPEDIA OF GLOBAL WARMING AND CLIMATE CHANGE 163, 163–65 (S. George Philander ed., 2008).

[17] *See* HENSON, *supra* note 14, at 19–27; MARK LYNAS, SIX DEGREES: OUR FUTURE ON A HOTTER PLANET, at xx–xxi (2007); NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW 9–11 (2007).

[18] *See* STERN, *supra* note 17, at 195–99; Ari Bessendorf, Note, *Games in the Hothouse: Theoretical Dimensions in Climate Change*, 28 SUFFOLK TRANSNAT'L L. REV. 325, 329 (2005).

[19] *See* HENSON, *supra* note 14, at 36–38; STERN, *supra* note 17, at 195–99; Bessendorf, *supra* note 18, at 329.

[20] *See* STERN, *supra* note 17, at 196; Andrew Hund, *Carbon Footprints*, *in* 1 ENCYCLOPEDIA OF GLOBAL WARMING AND CLIMATE CHANGE, *supra* note 16, at 166, 166–67.

[21] *U.S. and World Population Clocks*, U.S. CENSUS BUREAU, http://www.census.gov/main/www/popclock.html (last revised Dec. 21, 2010).

[22] *See* STERN, *supra* note 17, at 202–03. It is estimated that human activities now produce approximately 27,500 million tons of CO_2 annually. Hund, *supra* note 20, at 166–67. While China became the number one emitter of CO_2 in 2006, the United States still surpasses China in emissions on a per capita basis, with each person emitting 42,500 pounds of CO_2 annually. *Id.*

[23] *See* HENSON, *supra* note 14, at 19–30; Bessendorf, *supra* note 18, at 326–28.

[24] *See* Hund, *supra* note 20, at 167 ("[T]he average U.S. citizen is responsible for 42,500 pounds or 19,278 kilograms of CO_2 as a result of heating and electricity for living spaces, driving, traveling by airplane, and purchasing manufactured products.").

[25] *See* MARTIN GORKE, THE DEATH OF OUR PLANET'S SPECIES: A CHALLENGE TO ECOLOGY AND ETHICS 3–4 (2003).

including those we have not yet even seen.[26] And, tragically, like Eckels, we cannot go back and fix things.[27]

I. Climate Change and Invasive Species

A Sound of Thunder is not only a metaphor for extreme biological determinism and exponential increases in biological harm, it is also a metaphor for the devastating effect of invasive species.[28] In Bradbury's tale, it is Eckels, a single human from another time, who is the invasive species.[29] Ironically, as we try to feed and house nearly 6.9 billion people,[30] with a projected increase to 9.1 billion by 2050,[31] all of humanity has become an invasive species—and a very successful one at that.[32] We no longer have any natural enemies;[33] we are extraordinarily adaptable and able to thrive under almost any environmental conditions.[34] Worse, we are able to develop technologies that magnify our already formidable capabilities by many orders of magnitude.[35] Like Eckels's single, unfortuitous boot print, our collective carbon footprint is bringing disastrous, cascading, and intensifying change to literally every part of our once Edenic planet.[36]

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[26] *See* David S. Wilcove & Lawrence L. Master, *How Many Endangered Species Are There in the United States?*, 3 Frontiers in Ecology and the Env't 414, 414 (2005).

[27] *See* Lynas, *supra* note 17, at 264–65 (discussing tipping points and our ability to limit the effects of global warming). *See generally* Bradbury, *supra* note 2, at 240–41.

[28] *See* Harold A. Mooney, *Invasive Alien Species: the Nature of the Problem*, *in* Invasive Alien Species: A New Synthesis 1, 5–10 (Harold A. Mooney et al. eds., 2005) (describing the detrimental impact of invasive species). *See generally* Bradbury, *supra* note 2, at 234–35.

[29] *See* Bradbury, *supra* note 2, at 237; Tim M. Blackburn & Kevin J. Gaston, *Biological Invasions and the Loss of Birds on Islands: Insights into the Idiosyncrasies of Extinction*, *in* Species Invasions: Insights into Ecology, Evolution, and Biogeography 85, 87 (Dov F. Sax et al. eds., 2005) (noting that humans meet the definition of "exotic invader"). *See generally* Mooney, *supra* note 28, at 1–6 (describing what invasive species are and why they succeed).

[30] *U.S. and World Population Clocks*, U.S. Census Bureau, http://www.census.gov/main/www/popclock.html (last revised Dec. 21, 2010).

[31] Stern, *supra* note 17, at 209.

[32] *See* Blackburn & Gaston, *supra* note 29, at 87.

[33] See Philip Lieberman, Eve Spoke: Human Language and Human Evolution 30 (1998).

[34] Garry Peterson et al., *Uncertainty, Climate Change, and Adaptive Management*, Ecology & Soc'y, Dec. 1997, http://www.ecologyandsociety.org/vol1/iss2/art4/ ("Unlike other species, humans have the ability to plan for the future and to invest in technology and learning to mitigate and adapt to future changes.").

[35] *See id.*

[36] *See supra* text accompanying notes 17–27 (noting that our collective actions impact atmospheric carbon levels); *infra* Parts I.A–.B (noting that rising levels of carbon may lead to rising sea levels and an increase in the introduction of invasive species to many ecosystems).

However, this Article is not about humanity as an invasive species. Instead, it is about how humanity has helped spread invasive species around the world and the consequences these invasions will have on native species. Accordingly, one purpose of this Article is to draw attention to the enormously important but surprisingly little known connections between global climate change, migrations of invasive species and extinctions of native species.[37] Another purpose is to examine what negative effects these connections will have on land protected in perpetuity by conservation easements and what can be done to minimize or mitigate these effects.[38]

A. *Planet Carbon*

This Article is not about global warming itself, but instead about one of the many catastrophes it will cause. Nevertheless, some explanation of the phenomenon is warranted.[39] The concentration of carbon dioxide in the atmosphere rose markedly with the Industrial Revolution. Pre-industrial carbon dioxide levels are estimated at between 270

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[37] *See infra* Part I.B (discussing the phenomenon of "climate surfing"). *See generally* Gorke, *supra* note 25, at 3 (noting the connection between climate change and species extinctions).

[38] *See infra* Part IV.

[39] For the most recent institutional report on climate change in the United States, see U.S. Global Change Research Program, Global Climate Change Impacts in the United States, (Thomas R. Karl et al. eds., 2009), http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf (a remarkably candid and disturbing report commissioned by the George W. Bush Administration and written for the sophisticated layperson with minimum scientific jargon). For the most comprehensive collection of global warming data and analysis to date, see Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis (S. Solomon et al. eds., 2007), Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability (M. L. Parry et al. eds., 2007), Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change (B. Metz et al. eds., 2007), which are collectively known as the "Fourth Assessment Report." Also see Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report (R.K. Pachauri & A. Reisinger eds., 2007) [hereinafter IPCC Synthesis], which is a summary of the voluminous Fourth Assessment Report. Note that the Fourth Assessment Report was updated in the publication, University of Copenhagen, Synthesis Report, Climate Change: Global Risks, Challenges & Decisions (2009), *available at* http://climatecongress.ku.dk/pdf/synthesisreport, developed for the United Nations Framework Convention on Climate Change meeting held in Copenhagen in December of 2009. Additionally, the Intergovernmental Panel on Climate Change is currently working on a Fifth Assessment Report. *See also* Wilfried Thuiller, *Q&A Biodiversity: Climate Change and the Ecologist*, Nature, 2 Aug. 2007, at 550, 550–52.

and 280 parts per million.[40] The current level of carbon dioxide is at approximately 385 parts per million.[41] Some leading scientists have estimated that a concentration as low as 350 parts per million represents the maximum allowable level of carbon dioxide in the atmosphere to "maintain the climate to which humanity, wildlife, and the rest of the biosphere are adapted."[42]

Clearly, 385 parts per million is above this estimated target, and "is already in the dangerous zone."[43] This number has little meaning in isolation, but its consequences are staggering.[44] The global scientific community has concluded that we may see sea levels rise up to two meters by 2100 as a result of climate change.[45] This likely rise in sea levels results from various temperature-influenced phenomenon, from the melting of land ice (notably Greenland and the Antarctic) to the expansion of the water itself.[46] This spells disaster for the millions of people who inhabit lands that are already mere meters above sea level.[47] Such a concentration of greenhouse gases portends additional global-scale disasters, including increased severity of major weather events,[48] mass human relocation, and attendant civil, social, and political strife.[49] Of course, humanity will not be the only victim of global warming.[50] Just as millions of people will engage in mass migrations in search of food, water, and shelter, almost all species will also face climate-change-induced migrations.[51]

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[40] U. Siegenthaler & H. Oeschger, *Biospheric CO_2 Emissions During the Past 200 Years Reconstructed by Deconvolution of Ice Core Data*, 39B TELLUS B 140, 140 (1987); Waskey, *supra* note 16, at 165.

[41] James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 OPEN ATMOSPHERIC SCI. J. 217, 228 (2008); s*ee also* Waskey, *supra* note 16, at 165 (noting that in 2008, the level of carbon dioxide was at "380 ppm and rising").

[42] Hansen, *supra* note 41, at 218.

[43] *Id.*

[44] *See* IPCC SYNTHESIS, *supra* note 39, at 66–67; STERN, *supra* note 17, at xv–xvi; Waskey, *supra* note 16, at 165 ("It is estimated that 450 ppm may be a kind of trigger for major weather changes that may be permanent . . . .").

[45] Jason A. Lowe & Jonathan M. Gregory, *A Sea of Uncertainty*, NATURE REPORTS CLIMATE CHANGE (Apr. 6, 2010), http://www.nature.com/climate/2010/1004/full/climate.2010.30.html.

[46] *See* HENSON, *supra* note 14, at 82–88; IPCC SYNTHESIS, *supra* note 39, at 73; LYNAS, *supra* note 17, at 72–78; STERN, *supra* note 17, at 152.

[47] *See* LYNAS, *supra* note 17, at 52–53; STERN, *supra* note 17, at 138–39.

[48] *See* LYNAS, *supra* note 17, at 51.

[49] *See* STERN, *supra* note 17, at 138–39.

[50] *See* GORKE, *supra* note 25, at 3.

[51] *See id.*

B. *Climate Surfing Species*

Most people are familiar with the curvy lines of topographic maps. By linking areas of similar elevations with these lines it is possible to make out land features such as mountains, canyons, and valleys.[52] We can use topographic maps for a number of purposes, including navigation in unfamiliar territory.[53] There is another type of map with a similar appearance—an isotherm map. However, the lines on an isotherm map represent areas of similar average temperatures.[54] Thus, where the gradient of a topographic map represents the difference in elevation between two points, the gradient of an isotherm map represents the difference in average temperature between two points.[55]

Isotherm maps become important when one understands that one of the effects of global climate change will be the wholesale migrations of entire species—and indeed entire biomes—as increases in average temperatures in their native climes send them northward, in search of climates similar to those in which they evolved.[56] Such "climate surfing" across isotherm lines will determine the survival, or extinction, of the climate surfing species as they arrive at stopping points along the way that may or may not be habitable.[57] Of greater interest for this Article, however, is that such climate surfing will mean life or death for the native species in those stopping places where successful climate surfing species have the potential to become invasive species.[58]

C. *Invasive Species: Plants, Pigs, Perch, and Parakeets*

While climate surfing species that invade new habitats are the main subject matter of this Article, it is worth examining other past and

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[52] *See* U.S. Geological Survey, Topographic Map Symbols, *available at* http://egsc.usgs.gov/isb/pubs/booklets/symbols/ (last modified Apr. 28, 2005).

[53] *See id.*

[54] *See Isotherms Mini Unit*, Middle Sch. Sci., http://middleschoolscience.com/isotherms.htm (last updated Jan. 2008); *Surface Products*, U. of Ill., http://ww2010.atmos.uiuc.edu/(Gh)/wx/surface.rxml (last visited Dec. 22, 2010).

[55] *See Isotherms Mini Unit*, *supra* note 54.

[56] *See* Richard J. Hobbs & Harold A. Mooney, *Invasive Species in a Changing World: The Interactions between Global Change and Invasives*, *in* Invasive Alien Species: A New Synthesis, *supra* note 28, at 310, 312–13.

[57] *See id.*

[58] *See infra* Part III. Not only will global warming stimulate migratory behavior in species, it will also further drive the colonization of newly encountered habitat by disrupting native ecosystems, e.g., by creating severe weather events that remove vegetation and create bare soil—conditions that make colonization for non-native species more likely. Gian-Reto Walther et al., *Alien Species in a Warmer World: Risks and Opportunities*, 24 Trends in Ecology and Evolution, 686, 686–88 (2009).

present incursions. Such incursions can be coarsely divided between deliberate human introduction of non-native species, and introductions where non-native species have managed to colonize new lands on their own, or with the unwitting help of humans.[59] A further distinction is made between incursions by non-native species that do little or no harm to their new ecosystems, and incursions where the non-native species create havoc in their new ecosystems.[60] Following standard nomenclature, such harmful species are referred to in this Article as invasive species.[61] Invasive species are particularly important to this Article as they are contributing to the current enormous extinctions rates we are creating on the planet.

1. Plant Invasive Species

History abounds with examples of deliberate introductions of non-native plant species.[62] For as long as humans have been scuttling back and forth over continents and across oceans, they have carried with them and deposited on foreign soil a remarkable number of plants.[63] For example, evidence exists that plants were traded and then introduced into new areas as early as the fourth century before the Common Era by use of the Shu-Yuan Du trade route linking India and China.[64] Other evidence suggests that plants have been moved and cultivated since 8000 years before the Common Era.[65]

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[59] *See* Cynthia S. Kolar & David M. Lodge, *Freshwater Nonindigenous Species: Interactions with Other Global Changes*, *in* Invasive Species in a Changing World 3, 22 (Harold A. Mooney & Richard J. Hobbs eds., 2000) (explaining that although "some ebb and flow of species across terrestrial and aquatic landscapes would occur without human intervention, human activities greatly increase the rate and spatial scale of species introductions" both directly and indirectly). According to one source, "[b]iotic exchange is rampant and humans as agents are effective in all regions of the globe." Michael J. Novacek & Elsa E. Cleland, *The Current Biodiversity Extinction Event: Scenarios for Mitigation and Recovery*, 98 Proc. Nat'l Acad. Sci. 5466, 5468 (2001).

[60] *See* Harold A. Mooney & Richard J. Hobbs, *Global Change and Invasive Species: Where Do We Go From Here?*, *in* Invasive Species in a Changing World, *supra* note 59, at 425, 429–30 (describing the difference between the non-native species that supply the bulk of our food, which are largely non-invasive, and non-native invasive species).

[61] *See* S. Lowe et al., 100 of the World's Worst Invasive Alien Species: A Selection from the Global Invasive Species Database 3 (2004), *available at* http://www.issg.org/database/species/reference_files/100English.pdf; *see also* Harold A. Mooney & Richard J. Hobbs, *Introduction* to Invasive Species in a Changing World, *supra* note 59, at xiii, xiii.

[62] *See* Julie L. Lockwood et al., Invasion Ecology 21–28 (2007).

[63] *See id.* at 22.

[64] *Id.*

[65] *Id.* at 21.

Given its colonial origins, it should not be surprising that the United States harbors huge numbers of non-native species.[66] Looking just at plants, the United States is "home" to at least 5000 introduced plant species, compared with 17,000 native plants.[67] About "[h]alf of the wild poisonous plants in North America are introduced, as are half the earthworms in the soil."[68] Over the years plants have been relocated to the United States for a number of reasons, including ornamental, medicinal, and agricultural purposes.[69] In fact, many non-native plant species have been so successful in their new environments and have coexisted with humans for so long that they are considered native by all but those who have scientific knowledge of their true origins.[70] Such "adoptions" can occur whether the species was introduced deliberately or accidentally.[71] This phenomenon occurs with other, non-plant species as well.[72]

2. Animal Invasive Species

As is the case with plants, deliberate introductions of animal species abound.[73] One deliberately introduced species that has flourished for so long that it is now considered indigenous is Hawaii's feral pig.[74] While the feral pig has many detractors, it has also attracted a vocal group of supporters, namely those who hunt the pigs for food and sport.[75] Just as the feral pig was introduced to Hawaii by Polynesians as

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[66] *See id.* at 22 (explaining that the first European settlers brought non-native species in the form of "crops, medicinals, herbs, and domesticated animals they felt were necessary for their immediate survival in an unknown, hostile environment").

[67] Alan Burdick, Out of Eden: An Odyssey of Ecological Invasion 8 (2005).

[68] *Id.*

[69] *See* Lockwood et al., *supra* note 62, at 22, 24.

[70] *See, e.g.*, Vic Ramey, *Non-Native Invasive Plants: An Introduction*, Center for Aquatic & Invasive Plants, U. of Fl. (2005), http://plants.ifas.ufl.edu/guide/invplant.html (describing which plants in Florida are native and which are not, citing the water fern as being "so common now that most people think that it's a native").

[71] *See* Lockwood et al., *supra* note 62, at 21–29 (explaining both the direct and indirect ways invasive species can arrive, and how common they can become, pointing to examples such as St. John's Wort and kudzu).

[72] *See, e.g.*, Peter Coates, American Perceptions of Immigrant and Invasive Species: Strangers on the Land 7 (2006) (describing the English sparrow and the starling as examples of non-native species that have been in the United States so long that they are "naturalized").

[73] *See* Lockwood et al., *supra* note 62, at 22 (documenting the introduction of non-native animal species for food and game).

[74] *See* Burdick, *supra* note 67, at 114.

[75] *Id.*

a docile, domesticated animal,[76] domesticated animals have accompanied humans on many major human migrations.[77] No doubt many of these domesticated animals escaped and, if they survived in sufficient numbers to maintain viable populations, became feral.[78] Given the variety and duration of human relationships with various animal species, it is not surprising that there would be many instances of accidental and deliberate introductions.[79] Human interactions with animals include the use of animals as beasts of burden for carrying people and their possessions, as machines to pull plows and to assist in other agricultural endeavors, as game species to be hunted, as pest control,[80] as pets, and as food.[81]

3. Aquatic Invasive Species

Introductions of aquatic species likewise abound.[82] Among the examples of introduced non-native aquatic species that have become invasive are: the Nile Perch (since its introduction into England's Lake

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[76] *See id.*

[77] *See* LOCKWOOD ET AL., *supra* note 62, at 24–27 (explaining that animals were brought to new habitats as pets and as livestock).

[78] *See, e.g.*, DAVID QUAMMEN, THE SONG OF THE DODO: ISLAND BIOGEOGRAPHY IN AN AGE OF EXTINCTIONS 317 (1996) (describing the introduction of domestic cattle, sheep, mongooses, cats, donkeys, horses, and wallabies, which all subsequently went feral in Hawaii).

[79] *See* LOCKWOOD ET AL., *supra* note 62, at 21–29.

[80] For an amusing and shocking documentary of a deliberate introduction of a non-native species gone terribly wrong, see the movie "Cane Toad," written and directed by Mark Lewis in 1988. CANE TOAD (First Run Features 1988). Cane toads, which are native to the southern United States, Central America, and South America, were deliberately introduced in Australia in 1935 to control outbreaks of cane beetles. *Cane Toad*, NAT'L GEOGRAPHIC, http://animals.nationalgeographic.com/animals/amphibians/cane-toad/ (last visited Dec. 22, 2010). The cane toads failed to control the cane beetles but became extremely successful at propagating themselves. *Id.* Starting with an initial introduction of 3000 toads, they now number in the millions and they continue to expand their range, despite sustained efforts to eradicate them. *Id.* Cane toads are quite large, sometimes weighing up to four pounds. MARK CARWARDINE, ANIMAL RECORDS 182 (2008) (noting that the largest toad ever recorded was a five pound cane toad). Among their other unpleasant qualities, they contain a natural poison in their bodies which they also exude from their skin. *Cane Toad*, NAT'L GEOGRAPHIC, http://animals.nationalgeographic.com/animals/amphibians/cane-toad/ (last visited Dec. 22, 2010). Native species that attempt to eat cane toads often die from ingestion of the poison. *Id.*

[81] *See* LOCKWOOD ET AL., *supra* note 62, at 22–28; Jennifer Kendall, *American Livestock Breeds from Colonial Times*, GRIT (May/June 2010), http://www.grit.com/livestock/american-livestock-breeds-from-colonial-times.aspx (noting that the Pilgrims brought animals with them to America to use for food, clothing, and labor).

[82] *See Aquatic Biodiversity: Exotic Species*, U.S. ENVTL. PROTECTION AGENCY, http://www.epa.gov/bioiweb1/aquatic/exotic.html (last updated Dec. 8, 2010).

Victoria it has decimated at least 200 native cichlids);[83] the sea lamprey (introduced into the upper Great Lakes in 1829, by 1946 it had colonized all the Great Lakes and had begun edging out native trout populations);[84] and the champion of fresh water invaders, the zebra mussel. Not only is the zebra mussel incredibly prolific and competitive with native species, it also has an impressive ability to clog up, befoul, and encrust almost any human machinery in its new territories.[85] Indeed, the number of introductions of non-native aquatic species is so great as to be uncountable.[86] A major, reckless cause of the accidental introduction of non-native, aquatic species is the use of seawater for ballast to stabilize oceangoing vessels.[87] Remarkably, this process has been ongoing since the 1840s,[88] and modern ships have evolved to the point that they can carry ballast water in the tens of millions of gallons.[89] In the typical scenario, ships take on ballast water in one harbor and then pump the ballast water in the destination harbor where it is no longer needed for ballast.[90] Ballast water is now known to carry a very large number of species, many of which become successful in their new habitats.[91] Unfortunately, the study of introduced aquatic species is severely handicapped because non-native introductions began long before the phenomenon of invasive aquatic species became a subject of scientific study.[92] As a consequence, scientists have no baseline against which introductions can be measured.[93] Indeed, this fact challenges the notion of "naturalness" because scientists have no way of differentiating between original, natural species distributions and those that were long

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[83] LOCKWOOD ET AL., *supra* note 62, at 195.

[84] Kolar & Lodge, *supra* note 59, at 8.

[85] BURDICK, *supra* note 67, at 224–25.

[86] *Aquatic Biodiversity: Exotic Species*, *supra* note 82 (emphasizing the number of non-native aquatic species in the United States, "[i]t has been reported that ship ballast water is responsible for the transport of approximately 3000 species worldwide each day").

[87] LOCKWOOD ET AL., *supra* note 62, at 28–29, 61–62.

[88] James T. Carlton, *Global Change and Biological Invasions in the Oceans*, *in* INVASIVE SPECIES IN A CHANGING WORLD, *supra* note 59, at 31, 36.

[89] Kolar & Lodge, *supra* note 59, at 23.

[90] *Factsheet: Ballast Water & Aquatic Invasive Species*, U.S. ENVTL. PROTECTION AGENCY, http://water.epa.gov/type/oceb/habitat/upload/2007_03_16_invasive_species_ballastwaterFINAL. pdf (last visited Dec. 22, 2010).

[91] *See* Carlton, *supra* note 88, at 36.

[92] *See* BURDICK, *supra* note 67, at 219 ("[T]he modern study of marine biological invasion began . . . in 1962 . . . ."); Carlton, *supra* note 88, at 36 (noting that ship ballast introductions have been ongoing since the 1840s).

[93] *See* BURDICK, *supra* note 67, at 242 (noting that because much of ecological history has been "washed over," it is difficult for scientists to understand the events leading to the formation of marine ecological communities).

ago invaded by species which have not only survived but have created their own ecosystems.[94]

4. Avian Invasive Species

Equally as notorious as plant, animal, and aquatic introductions are the many deliberate avian introductions.[95] Among the reasons for such introductions include as prey for hunting, as a food source, and as pest control.[96] Perhaps more than other taxa, birds have been introduced for aesthetic purposes, including not only their physical appearance but for their song as well.[97] As humans have themselves invaded new lands, they have brought with them, or later acquired, various bird species from their former homes to make their new homes more familiar and perhaps less threatening.[98] In addition to deliberate introductions of birds into the wild, many birds have been domesticated as pets, some of which have escaped into the wild where they have become invasive species, parakeets for example.[99] Some introduced avian species have even been so successful in adapting to their new environments that they are now considered native. Two classic examples of such successful adaptations are the English sparrow and the Starling.[100]

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[94] *See id.* The phenomenon of lost ecological history in the context of invasive aquatic species is poetically described in this quotation: "Unanchored by a definitive past, a marine scientist floats in the eternal present, like a sentence on the printed page. You can read the finished line, but you can never glimpse the crafting hand—its insertions, erasures, second thoughts—that honed it finally to a single word: *cryptogenic*." *Id.*

[95] *See, e.g.*, COATES, *supra* note 72, at 6 (2006); E.A. Zimmerman, *House Sparrow History*, SIALIS, http://www.sialis.org/hosphistory.htm (last updated Mar. 12, 2010).

[96] *See* COATES, *supra* note 72, at 35.

[97] *Id.*; Steve Eno, *House Sparrows*, AUDUBON SOC'Y OF OMAHA, http://audubon-omaha.org/bbbox/ban/hsbyse.htm (last visited Dec. 22, 2010) (noting that immigrants missed the sight of these birds).

[98] *See* COATES, *supra* note 72, at 35.

[99] *The Most Invasive Birds*, CONN. MUSEUM QUEST (May 17, 2008), http://www.ctmuseumquest.com/?page_id=2207.

[100] *See id.* at 6–7. The introduction of the European starling to the United States was, depending upon one's tastes, a charming result or the product of a paucity of understanding the workings of nature. *See id.* The best telling of this story is quoted below.

> European starlings were introduced to America by a New Yorker, Eugene Schieffelin, in Central Park in 1890. Schieffelin was the chairman of the American Acclimatization Society, a group of scientists and naturalists that sought to introduce animal species to North America. In 1864, they released English sparrows in Central Park and also introduced, or attempted to introduce, Japanese finches, Java sparrows, English blackbirds, and the English titmouse, among many others. They corresponded with other acclimatization societies, such as the Cincinnati society, which successfully introduced the skylark in Ohio. The society was also interested in introducing American fish to

II. Land Trusts and Conservation Easements

A. *Land Trusts*

There are a number of ways in which land is protected from development and thereby maintained in as natural a state as possible.[101] Local, state, and federal parks, nature reserves, and even military bases are familiar examples of such protection.[102] Land can also be protected by fee title ownership where the landowner seeks to keep the land in its natural state. However, this Article focuses on the recent and increasingly widespread protection of land by land trusts through the use of perpetual conservation easements.

Land trusts represent a remarkable phenomenon in the history of environmental protection in the United States. With few exceptions, land trusts are 501(c)(3) charitable corporations that preserve land using market forces.[103] For example, land trusts sometimes purchase land in fee title from a landowner.[104] Alternatively, land is sometimes donated in fee title to land trusts by the landowner in return for a federal income tax deduction.[105] When land is transferred in fee title, it is often retained by the purchasing land trust and protected by ongoing stewardship of the natural character of the land and by prohibitions on any form of development on the land.[106] Another means for land trusts to protect property using market forces is to acquire conservation easements on property.

> European rivers. Introducing starlings in Central Park was only a part of Schieffelin's plan to introduce to North America all of the birds mentioned in the works of Shakespeare.

Robert Sullivan, Rats: Observations on the History and Habitat of the City's Most Unwanted Inhabitants 171 (2004).

[101] *See* Ala. Dep't of Conservation & Nat. Resources, The Forever Wild Land Trust: An Interim Report to the Citizens of Alabama—1992 Through 2009, at 6 (2010), *available at* http://www.outdooralabama.com/public-lands/stateLands/foreverWild/ForeverWildReport.pdf.

[102] *Id.*

[103] *See* Richard Brewer, Conservancy: The Land Trust Movement in America 9 (2003).

[104] *See id.* at 142.

[105] *See id.* at 141; Elizabeth Byers & Karin Marchetti Ponte, The Conservation Easement Handbook 80 (2d ed. 2005).

[106] *See* Brewer, *supra* note 103, at 5.

B. *Conservation Easements*

A conservation easement grants a land trust the right to prevent certain uses on land that someone else owns, generally to prevent development.[107] Conservation easements thus allow the land trust to monitor and provide stewardship to the property while allowing the landowner to remain on the property as the owner.[108]

Conservation easement transactions are more complex than fee title acquisitions.[109] Conservation easement transactions often involve both state and federal law, as almost all states have state enabling statutes that govern conservation easement transactions,[110] and often landowners are motivated by federal tax incentives that are specified in federal law and regulations.[111] In a conservation easement transaction, a landowner donates or sells a conservation easement to a qualifying land trust and the easement, at minimum, protects the easement land from any form of development.[112] Many conservation easements carry such protection of the land a step further and provide for restoration and remediation of natural features of the land.[113]

Like other forms of easements, conservation easements are recorded in the chain of title of the easement property and run with the land, thus binding all future landowners to the agreements reached in the conservation easement.[114] However, unlike other forms of easements, the holder of the conservation easement holds it independent of any other landownership, so the easement is not tied to an adjacent, dominant parcel,[115] which allows the conservation easement to benefit the public at large rather than a particular parcel of land.[116] This type of easement ownership is described in legal terms as "in gross," and it

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[107] *See* Jean Hocker *Foreword* to PROTECTING THE LAND: CONSERVATION EASEMENTS PAST, PRESENT, AND FUTURE, at xvii, 373 (Julie Ann Gustanski & Roderick H. Squires eds., 2000).

[108] *See* BREWER, *supra* note 103, at 5.

[109] *See generally* William T. Hutton, *Conservation Easements in the Ninth Federal Circuit*, *in* PROTECTING THE LAND: CONSERVATION EASEMENTS PAST, PRESENT, AND FUTURE, *supra* note 107, at 354, 373 (noting that conservation easements are complex mechanisms).

[110] *See* BYERS & PONTE, *supra* note 105, at 86–87; Todd D. Mayo, *A Holistic Examination of the Law of Conservation Easements*, *in* PROTECTING THE LAND: CONSERVATION EASEMENTS PAST, PRESENT, AND FUTURE, *supra* note 107, at 26, 27–31.

[111] *See* BYERS & PONTE, *supra* note 105, at 23.

[112] *See* BREWER, *supra* note 103, at 146.

[113] *See* BYERS & PONTE, *supra* note 105, at 224–25.

[114] *See id.* at 21.

[115] *See* Hocker, *supra* note 107, at xvii.

[116] *See id.*

allows ownership of the easement to be transferred to other qualifying entities, such as a governmental entity.[117]

Perhaps the most remarkable attribute of conservation easements is that they are generally expected to be perpetual.[118] Perpetuity, literally meaning "forever,"[119] is partially the result of application of federal law creating tax incentives for donated conservation easements.[120] Such laws require that conservation easements contain language expressly making them perpetual in duration.[121] Additionally, most state enabling statutes have default rules favoring perpetuity and four states expressly require conservation easements to be perpetual.[122] The expectation of perpetuity leads to conservation easements that will be in place for a very long time, which can be expected to leave a legacy of environmental protection and preservation unmatched by other state and federal environmental laws in the United States.

III. Vignettes of Nature and Landscapes of Extinction

A. *Vignettes of Nature*

The preservation of natural lands and open spaces in perpetuity is a worthy ambition. When we help to preserve land, and its species, in perpetuity we can feel that we have conferred an ecological benefit to the planet that will long outlive us, a sort of "vignette of nature" that will remain static and immutable literally forever.[123] This aspiration is mirrored in the legal underpinnings of federal tax law governing donated conservation easements.[124] One of the most critical requirements for the donor of a perpetual conservation easement to be eligible for a tax deduction is that the donor prepares a baseline environmental report that is in effect a snapshot of the condition of the easement property and its biome at the time of the donation.[125] The baseline report is then used as a form of ecological yardstick to measure the landowner's

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[117] *See* Byers & Ponte, *supra* note 105, at 173–74 (noting that a conservation easement may be transferred).

[118] *See id.* at 21.

[119] Black's Law Dictionary 1256 (9th ed. 2009).

[120] *See* Mayo, *supra* note 110, at 42.

[121] *See id.*

[122] *See id.* at 40–42.

[123] *See* Brewer, *supra* note 103, at 160.

[124] *See* Byers & Ponte, *supra* note 105, at 83 (citing I.R.C. § 170(h) (2006)).

[125] *See id.* at 100; James L. Olmsted, *Climate Surfing: A Conceptual Guide to Drafting Conservation Easements in the Age of Global Warming*, 23 St. John's J. Legal Comment. 765, 835–36 (2008).

compliance, or lack thereof, with the protective terms of the conservation easement, presumably in perpetuity.[126] Thus, use of conservation easements for land protection is based on the assumption that species populations and ecosystems are static unless disturbed directly by human action.[127] As noted earlier, this assumption, pleasing as it might be, is turning out to be fictitious as it becomes ever more apparent that using perpetual conservation easements designed to protect static "vignettes" of nature is at odds with the true character of nature as ever changing, non-cyclical, and stochastic. This disconnect is particularly acute as anthropogenically caused global climate change rearranges nature on every level, from the smallest micro fauna and micro flora to entire continents such as Greenland.[128]

B. *Landscapes of Extinction*

As noted earlier, the scenarios addressed in this Article are being played out against a background of planetary extinctions. The vast majority of scientists agree that these elevated background extinction rates are caused by humans and are far above the normal background rates that existed before human habitation.[129] Indeed, many scientists warn that humanity has set in motion irrevocable changes that will lead to the sixth-greatest extinction in the history of the planet.[130] This extinc-

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[126] *See* Byers & Ponte, *supra* note 105, at 100, 120–21.

[127] *See* Duncan M. Greene, Comment, *Dynamic Conservation Easements: Facing the Problem of Perpetuity in Land Conservation*, 28 Seattle U. L. Rev. 883, 884 (2005).

[128] *See* Olmsted, *supra* note 125, at 836 (implying that the value of baseline documentation may be undermined by the "abrupt and profound changes to virtually all of [the world's] major natural systems as a result of human-caused climate change"); *supra* Part I.A (discussing the negative effects of man-made climate change on species of all taxa).

[129] *See* F. Stuart Chapin III et al., *Consequences of Changing Biodiversity*, Nature, May 11, 2000, at 234, 234 ("Human alteration of the global environment has triggered the sixth major extinction event in the history of life . . . ."); Jason F. Shogren & Patricia H. Hayward, *Biological Effectiveness and Economic Impacts of the Endangered Species Act*, 32 Land & Water L. Rev. 531, 534 (1997) ("Most scientists agree, however, that today's extinction rates go far beyond 'background' levels.").

[130] *See* Terry Glavin, The Sixth Extinction: Journey Among the Lost and Left Behind 35 (2006); Martin Gorke, The Death of Our Planet's Species 2–4 (2003); David Quammen, *supra* note 78, at 606–08(1996); *see also* Edward O. Wilson, Biophilia 121–22(1984) ("Extinction is accelerating and could reach ruinous proportions during the next twenty years."); Chapin et al., *supra* note 129, at 234 ("Human alteration of the global environment has triggered the sixth major extinction event in the history of life and caused widespread changes in the global distribution of organisms."). Ironically, the year 2010 was designated by the United Nations as the "International Year of Biodiversity." *See Welcome,* United Nations Int'l Year of Biodiversity, http://www.cbd.int/2010/welcome (last visited Dec. 22, 2010).

tion will affect all of Earth's creatures.[131] Thus, not only will we lose the charismatic mega-fauna—the lions and tigers and bears—but also plant species, aquatic species, insect species, avian species, and even the cryptic micro flora and micro fauna that support all of the complex food chains on earth.[132] Worse yet, extinctions not only switch the lights off for individual species, extinctions are the leading cause of biodiversity loss on the planet.[133] As biodiversity is itself a requirement for species survival, the loss of biodiversity contributes to exponential increases in extinction rates.

It is well established that humanity's most devastating contribution to the current mass extinction is destruction and appropriation of natural habitat.[134] It is equally well established that the second greatest cause of extinctions, also mediated by humanity, is the introduction of invasive species into formerly pristine ecosystems. [135] As has been discussed, humanity introduces non-native species in a variety of ways, some deliberate and some not. Of primary importance for this Article is the human caused introduction of non-native species through the operation of anthropogenic climate change that will cause almost every category of organism on the planet to migrate to cooler temperatures and, in so doing, to invade new territories, many of which will be on lands presumably protected in perpetuity by conservation easements.

As most conservation easements make protection of native species and ecosystems a core conservation value, species invasions are a threat to continued implementation of many conservation easements. The creation of a conservation easement typically requires enormous investments of effort, time, and money.[136] Thus, the potential failure of conservation easements due to migrating species invading new habitats

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[131] *See* Chapin et al., *supra* note 129, at 234–35 (noting that human activities have already led to the extinction of species in many groups, including mammals, fish, birds, and plants).

[132] *See* John Charles Kunich, *Losing Nemo: The Mass Extinction Now Threatening the World's Ocean Hotspots*, 30 COLUM. J. ENVTL. L. 1, 3 (2005); *The Food Web*, WATER ON THE WEB, http://www.waterontheweb.org/under/lakeecology/11_foodweb.html (last updated Mar. 3, 2004) (explaining that microorganisms, such as phytoplankton, form the base of the food pyramid and support all other trophic levels of the food chain).

[133] *See* E.O. WILSON, THE FUTURE OF LIFE 98–99, 102 (2002); *see also* Robert W. Sutherst, *Climate Change and Invasive Species: A Conceptual Framework*, *in* INVASIVE SPECIES IN A CHANGING WORLD, *supra* note 59, at 211, 232 ("Invasive species are now recognized as being responsible for significant losses of biodiversity, and global [climate] change is likely to accelerate those losses by increasing disturbance and stressing native species at the margins of the distributions of native species.").

[134] *See* Sutherst, *supra* note 133, at 211, 232.

[135] *See id.*

[136] *See* BREWER, *supra* note 103, at 135–36.

can represent huge costs in terms of social resources that will be sorely needed for other preservation efforts.[137]

IV. Drafting Conservation Easements in the Age of Global Warming

Conservation easement drafting is complicated even for experienced lawyers. Conservation easements are not user friendly and conservation easement drafting is not for amateurs.[138] This is particularly true for perpetual conservation easements that are donated for purposes of achieving a tax deduction on federal income taxes.[139]

There are a number of reasons for the difficulty in conservation easement drafting.[140] One is that every conservation easement is different because, like contracts, they involve different parties and different issues.[141] There is no "one-size-fits-all" in conservation easement drafting.[142] Another reason for the difficulty is that conservation easements are driven by formalities to the extent that they represent deeds of interests in land which must meet the requirements for recordation in the chain of title.[143] However, the most challenging aspect of drafting conservation easements is avoiding the loss of perpetuity.[144]

Perpetuity is initially established in both donated and purchased conservation easements by express declarations that the easement is perpetual.[145] A perpetual easement runs with the burdened land from landowner to landowner, and can be assigned by one grantee to another qualified grantee.[146] Perpetuity must also be tied to the conservation purposes that the easement was drafted to protect.[147] The conservation

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[137] *See generally id.*

[138] *See* Byers & Ponte, *supra* note 105, at 284–85 (discussing the "immense variation in circumstances" that easement drafters must address).

[139] *See id.* at 296 ("Drafting easements to meet the requirements of particular federal or state tax incentives takes extra care.").

[140] *See id.* at 287, 290–91.

[141] *See id.* at 287 (noting that one of the difficulties of conservation easements is that they must be tailored to the facts of each plot of land and the goals of each grantor and holder).

[142] *See id.*

[143] *See generally id.* at 21, 290–91.

[144] *See* Greene, *supra* note 127, at 901–07 (discussing the "fundamental paradox" posed by the competing desires to draft specific easements to maximize protection of the land's current condition and to draft flexible easements to facilitate endurance in the face of changing conditions).

[145] *See id.* at 291.

[146] *See id.* at 17–19, 21.

[147] *See id.* at 83–84 (noting that a conservation easement must meet the "conservation purposes test" by being granted in perpetuity for a specific conservation purpose).

purposes almost always include the general purposes enumerated in the state enabling act and, for donated easements, the general purposes in the federal tax law.[148]

Perpetuity is lost, or perhaps never achieved, by the failure to include the formulaic language in the statutes such as that just described.[149] But perpetuity can be lost in other more subtle ways.[150] For example, an amendment provision that is unlimited in scope will almost always be held to destroy perpetuity.[151] This is because an unlimited amendment provision would allow the parties to contract out of preservation of certain conservation purposes or to otherwise limit the easement's protection of the conservation purposes.[152] Using amendment language as an example, it is now standard practice in the land trust community to limit amendments to only those that are neutral to or enhancing of the conservation purposes.[153]

One of the most complicated aspects of drafting perpetual conservation easements in the age of global warming is the tension between the need for flexible amendments to address potential future global warming scenarios,[154] and amendment provisions that are so open-ended they can cause the termination of an easement by loss of perpe-

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[148] *See id.* at 86 (noting that, while the IRS and state law often differ regarding what is a valid conservation purpose, easement donations *must* meet both requirements to assure validity and deductibility).

[149] *See id.* at 17–21 (discussing the importance of incorporating "precise and clear language" of conveyed rights and conservation purposes to ensure that the conservation purposes can be achieved); *see also* Mayo, *supra* note 110, at 45 (noting that when conservation purposes can no longer be achieved, a once "perpetual" easement may be terminated).

[150] *See* BYERS & PONTE, *supra* note 105, at 71–75; Nancy A. McLaughlin, *Amending Perpetual Conservation Easements: A Case Study of the Myrtle Grove Controversy*, 40 U. RICH. L. REV. 1031, 1072–73 (2006).

[151] *See* BYERS & PONTE, *supra* note 105, at 71–75 (discussing the importance of drafting easements with specifically defined scope, so as to ensure that conservation purposes can be met and the easement can be enforced); McLaughlin, *supra* note 150, at 1072–73 (noting that amendments that do not protect the original conservation purposes destroy perpetuity).

[152] *See* McLaughlin, *supra* note 150, at 1072–73.

[153] *See id.* at 1072–75, 1090.

[154] *See* Greene, *supra* note 127, at 884 (noting that characterizing a model of nature as "static and unchanging" is inaccurate, and that allowing more flexibility in drafting easements would better accommodate the fact that systems constantly change).

tuity.[155] Consequently, it is critically important to be aware of this tension and to draft perpetual easements accordingly.[156]

A. *A Relatively Natural Habitat: The Difficulty of Maintaining Conservation Easements Under Treasury Regulations*

Perpetuity is more challenging to maintain for donated conservation easements for which the donor will seek an income tax deduction than it is for a purchased conservation easement.[157] This is because the relevant federal tax law contains numerous technical requirements that must be met to achieve perpetuity in contrast with the far less complicated requirements of state easement-enabling statutes. Because the tax deduction for donated conservation easements has become a huge incentive for easement donations, it is critical to understand the perpetuity requirements under federal tax law.[158]

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[155] McLaughlin, *supra* note 150, at 1072–73 (discussing limitations to amending easements); *see also* Greene, *supra* note 127, at 901 ("Land trusts that use perpetual conservation easements face a fundamental paradox of land conservation: how to truly preserve land in perpetuity in the face of perpetual change.").

[156] *See* Byers & Ponte, *supra* note 105, at 183 (noting that it is necessary to draft easements to account for the possibility of changed conditions).

[157] One should always be aware of the operative law governing any given conservation easement. *See id.* at 85–87. Thus, perpetual conservation easements donated as tax deductible charitable gifts are governed by federal tax law and state law (including the relevant state easement-enabling statute and the state laws governing the administration of charitable gifts). *See id.* at 83, 86–87. Conservation easements that are purchased by (as opposed to donated to) governmental entities and land trusts need not satisfy federal tax law requirements and can be drafted to give the holder broad amendment and termination discretion, provided such discretion is consistent with the requirements of the state easement-enabling statute. *See* McLaughlin, *supra* note 150, at 1088–89 (discussing how easements that are purchased with unrestricted funds enjoy broad modification and termination capabilities, which would be contrary to the intent of the easement). Despite the fact that a purchased conservation easement meeting state statutory requirements but not federal tax law requirements could operate exactly as planned and do so in perpetuity, drafters often draft such purchased easements to comply with both state enabling act law and federal tax law. *See* Janet Diehl & Thomas S. Barrett, The Conservation Easement Handbook: Managing Land Conservation and Historic Preservation Easement Programs 12, 23 (1988) (noting that the IRS regulations serve as a useful model for conservation easement drafters, even if those easements are purchased rather than donated and thus "do not have to comply with IRS regulations," because they delineate a framework of workable easement criteria). As was noted on the University of Indiana Land Trust Listserv recently, "most land trusts view IRC requirements as establishing sort of a 'best practices' standard and require their easements to meet that standard even if there is no intention on anyone's part to achieve a charitable contribution deduction." Posting of George M. Covington, gcovington@SBCGLOBAL.NET, to landtrust-L@Listserv.indiana.edu (Apr. 5, 2010) (on file with the author).

[158] *See* Diehl & Barrett, *supra* note 157, at 12.

The foundational federal tax law governing conservation easements is found at 26 U.S.C. § 170(h).[159] This statute enumerates three factors which must be present to achieve a federal tax deduction for a donated, perpetual conservation easement: (1) the donation must be a qualified real property interest; (2) it must be to a qualified organization; and (3) it must be exclusively for a "conservation purpose."[160] As discussed below, it is the conservation purpose requirement that is most at risk in conservation easements that are subject to out-migrations and invasive species.[161] The legal consequence of the failure to protect the conservation purpose, or purposes, is the loss of perpetuity and, thereby, the loss of any favorable tax treatment from the easement donation,[162] and, perhaps, the extinguishment of the easement itself under state enabling law.[163]

Section 170(h) sets forth four conservation purposes, any one of which may form the basis for a federal income tax deduction.[164] The first purpose is "the preservation of land areas for outdoor recreation by, or the education of, the general public."[165] The second purpose is "the protection of a relatively natural habitat of fish, wildlife, or plants, or similar ecosystem."[166] The third purpose is "the preservation of open space."[167] The fourth purpose is "the preservation of an historically important land area or a certified historic structure."[168] Because of the increasing rate of species extinctions and ecosystem changes that climate change will produce, drafters of donated conservation easements should be most concerned with the second purpose, "the protection of a relatively natural habitat of fish, wildlife, or plants, or similar ecosys-

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[159] *See* Byers & Ponte, *supra* note 105, at 83.

[160] *See id.* Following standard conservation easement nomenclature, the "conservation purposes" are to protect individual and specific "conservation values." *See id.* at 85.

[161] *See infra* Part IV.B.

[162] *See* McLaughlin, *supra* note 150, at 1072–73.

[163] *See* Byers & Ponte, *supra* note 105, at 86 (noting that an easement must meet both federal and state laws to be valid); Mayo, *supra* note 110, at 45 (noting that state law provides for the termination of easements that no longer can meet their original conservation purposes).

[164] I.R.S. § 170(h)(4)(A)(i)–(iv) (2006).

[165] *Id.* § 170(h)(4)(A)(i).

[166] *Id.* § 170(h)(4)(A)(ii).

[167] *Id.* § 170(h)(4)(A)(iii).

[168] *Id.* § 170(h)(4)(A)(iv).

tem[s]."[169] However, a conservation easement can purport to further one or more of the enumerated purposes.[170]

Section 170(h) is explained and interpreted by regulations promulgated by the United States Treasury at section 1.170A-14.[171] Of these regulations, 1.170A-14(d)(3)(i) and (ii) address the protection of natural assets.[172] Because these regulations are awkwardly drafted and can generate confusion, they are set out in full below.

> *(i) In general.* The donation of a qualified real property interest to protect a significant relatively natural habitat in which a fish, wildlife, or plant community, or similar ecosystem normally lives will meet the conservation purposes test of this section. The fact that the habitat or environment has been altered to some extent by human activity will not result in a deduction being denied under this section if the fish, wildlife, or plants continue to exist there in a relatively natural state. For example, the preservation of a lake formed by a man-made dam or a salt pond formed by a man-made dike would meet the conservation purposes test if the lake or pond were a nature feeding area for a wildlife community that included rare, endangered, or threatened native species.
> *(ii) Significant habitat or ecosystem.* Significant habitats and ecosystems include, but are not limited to, habitats for rare, endangered, or threatened species of animal, fish, or plants; natural areas that represent high quality examples of a terrestrial community or aquatic community, such as islands that are undeveloped or not intensely developed where the coastal ecosystem is relatively intact; and natural areas which are included in, or which contribute to, the ecological viability of a

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[169] *See id.* § 170(h)(4)(A)(ii); *see also* Anna T. Moritz et al., *Biodiversity Baking and Boiling: Endangered Species Act Turning Down the Heat*, 44 TULSA L. REV. 205, 205 (2008) (discussing global warming's effect on rate of species extinction).

[170] Of the four conservation purposes discussed in this Article, climate change will most heavily impact the protection of "relatively natural habitat[s] of fish, wildlife, or plants, or similar ecosystem[s]." *See* 26 U.S.C. § 170(h)(4)(A)(ii). Consequently, many conservation easement drafters "hedge their bets" of achieving perpetuity by also stating in their conservation easements that they protect lands for other purposes, such as recreation, education for the general public, and for open space. *See* BYERS & PONTE, *supra* note 105, at 390–91 (noting that easements may serve multiple conservation purposes). Protection of habitat is the focus of this Article because, of all the conservation purposes, protection of habitat is ecologically the most important for biodiversity and also the most subject to climate change. *See id.*

[171] *See* I.R.S. § 170(h); Treas. Reg. § 1.170A-14 (2009).

[172] Treas. Reg. § 1.170A-14(d)(3)(i)–(ii).

> local, state, or national park, nature preserve, wildlife refuge, wilderness area, or other similar conservation area.[173]

As can be seen in the above regulation, the Treasury focuses on the protection of "relatively natural habitat" as a basis for a tax deduction.[174] This standard is tempered by language that allows a deduction for natural habitats even though they may have been "altered to some extent by human activity" so long as fish, wildlife, or plants remain on the land in a "relatively natural state."[175] Unfortunately, this relaxed standard is conditioned by an example provided in the same subsection which states that habitat that has been "altered to some extent" still qualifies as a "relatively natural habitat" if the easement land still maintains a "wildlife community that included rare, endangered, or threatened native species."[176] One interpretation of this seemingly inconsistent language in subsection (i) is that the protection of unaltered habitat meets the test, but if the habitat is altered the test is only met if the resident species are "rare, endangered, or threatened" and "native."[177] This interpretation is unavoidably problematic because the regulation fails to define the terms "rare, endangered, or threatened," leaving the reader to ponder if these words are used as terms of art as defined in the Endangered Species Act or if they apply outside of statutory law.[178] Thus, this interpretation leaves open the question of whether the native species in question must have formally and officially been listed as "endangered or threatened" under the Endangered Species Act or under some similar state version of the Endangered Species Act.[179]

Subsection (ii) likewise emphasizes the apparent requirement that the protected land contain rare, endangered, or threatened species.[180] Subsection (ii) also seems to create a second category of land, "natural areas that represent high quality examples of a terrestrial community or aquatic community," the preservation of which can result in a tax deduction.[181] As in subsection (i), the standard is relaxed by allowing donations for lands that are not "intensely developed [and] where the

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[173] *Id.*

[174] *Id.* § 1.170A-14(d)(3)(i).

[175] *Id.*

[176] *Id.*

[177] *See id.*

[178] *Compare* Treas. Reg. § 1.170A-14(d)(3)(i)–(ii), *with* Endangered Species Act § 3(6), (20), 16 U.S.C. § 1532(6), (20) (2006).

[179] *See* 16 U.S.C. § 1532(6), (20).

[180] *See* Treas. Reg. § 1.170A-14(d)(3)(ii).

[181] *See id.*

coastal ecosystem is relatively intact."[182] A third category is also created.[183] This category includes natural areas which are included in, or contribute to, the "ecological viability" of other preserved lands.[184]

A broad brush reading of the above subsections leads to the conclusion that the Treasury requires land under a conservation easement to exist in one or more of the following conditions: (1) undisturbed relatively natural habitat; (2) somewhat altered habitat that contains rare, endangered, or threatened native species; (3) high quality examples of terrestrial or aquatic communities; or (4) natural areas that contribute to the ecological viability of other preserved lands.[185]

As can be seen from the above regulations, the Treasury demonstrates at least some measure of bias for the protection of "native" species. As noted earlier, this is consistent with the "vignettes of nature" approach to conservation easements. However, in today's climate-changed world of constantly migrating species, one must speculate how the Treasury regulations would apply where native species have been displaced by non-native invasive species, or whether it is permissible to protect non-native species as biological "replacement species."[186] Thus, it is possible to imagine that the IRS might disallow a deduction based on the protection of a "relatively natural habitat" of fish, wildlife, or plants, or similar ecosystem in an ecosystem where climate surfing species have driven the native species to extinction.[187]

One means to bring some order to the problem of creating perpetual easements in a world of migratory flux is to categorize the types of questions we must ask ourselves in applying conservation easement law. For example, whether a habitat is "undisturbed" and "relatively natural" is a factual question to be answered by science. Likewise, whether a species is "native" to easement lands is also amenable to a scientific answer. Whether invasive species are driving down the native species is a factual question, one to be answered by monitoring the easement property. Whether species protected by a conservation easement are "rare, endangered, or threatened" is both a scientific question and a legal question because similar terminology exists in the federal Endangered Species Act and also in state statutes modeled after the Endangered Species

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[182] *See id.* § 1.170A-14(d)(3)(i)–(ii).
[183] *Id.* § 1.170A-14(d)(3)(ii).
[184] *Id.*
[185] *See id.* § 1.170A-14(d)(3)(i)–(ii).
[186] *See* Treas. Reg. § 1.170A-14.
[187] *See id.* § 1.170A-14(d)(3)(i).

Act.[188] The consequence of the loss of native species on land subject to a donated conservation easement is a legal question, one to be answered by lawyers, judges, and the IRS. Clearly, when it comes to assessing the perpetuity of a conservation easement, the successful land trust must rely not only on the qualifications of its staff, but also on the expertise of scientists and lawyers.[189]

B. *Modifying the Conservation Purposes to Maintain an Easement*

Whether a conservation easement is narrowly or broadly drafted in terms of the conservation purposes protected may determine whether the easement must be terminated if it becomes impossible or impractical to protect its conservation purposes.[190] For example, should climate-change-driven migrations result in invasive species driving native species to extinction, presumably the holder of the conservation easement will note this change in the distribution of species compared to the original distribution in the baseline report. If the conservation easement was narrowly drafted so that the only conservation purpose was the preservation of a single, specific species, and that species was the one driven to extinction, it may be necessary to terminate the easement because it is impossible or impractical to carry out the easement purposes.[191]

More typical, however, is for the conservation easement to contain broader language invoking the statutory purpose of "the protection of a relatively natural habitat of fish, wildlife, or plants, or similar ecosystem."[192] If this is the case, that purpose can be tested against the standards in subsections 1.170A-14(d)(3)(i) and (ii).[193] If, for example, the easement land still possesses "high quality examples of a terrestrial

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[188] *Compare id.* § 1.170A-14(d)(3)(i)–(ii), *with* Endangered Species Act § 3(6), (20), 16 U.S.C. § 1532(6), (20) (2006).

[189] For an in-depth discussion of laws governing alien species in the United States see Marc L. Miller, *The Paradox of U.S. Alien Species Law*, *in* Harmful Invasive Species: Legal Responses 125 (Marc L. Miller & Robert N. Fabian eds., 2004). Also visit the U.S. Department of Agriculture's *National Invasive Species Information Center (NISIC)*, http://www.invasivespeciesinfo.gov (last modified Jan. 11, 2011). *See also* Clare Shine et al., *Legal and Institutional Frameworks for Invasive Alien Species*, *in* Invasive Alien Species: A New Synthesis, *supra* note 28, at 233.

[190] *See* Treas. Reg. § 1.170A-14(g)(6)(i).

[191] *See id.* § 1.170A-14(g)(6); Nancy A. McLaughlin & W. William Weeks, *In Defense of Conservation Easements*, 9 Wyo. L. Rev. 1, 42 n.153 (2009); Nancy A. McLaughlin, *Rethinking the Perpetual Nature of Conservation Easements*, 29 Harv. Envtl. L. Rev. 421, 465–69 (2005); s*ee also* Restatement (Third) of Prop.: Servitudes § 7.11 (2000).

[192] *See* I.R.S. § 170(h)(4)(A)(ii) (2006).

[193] *See* Treas. Reg. § 1.170A-14(d)(3)(i)–(ii).

community or aquatic community," then termination of the easement is not required.[194]

In the above example, if a single species were driven to extinction, the easement would be salvageable because it contained broad language protecting entire habitats. What, then, are the consequences of a complete climate-change-caused biological meltdown, where the damage includes not only the loss of species but of protected habitat as well? Imagine, for example, that warmer temperatures cause an insect such as the pine beetle to migrate north in search of a cooler climate. If the pine beetle is successful in its migration, it will end up in a pine forest where it has no natural enemies and plenty of pine trees for food and shelter.[195] Eventually, the pine beetle will destroy the living pine trees and move on.[196] The dead pine trees may not be able to recover, and other species which depended upon a healthy forest might migrate or die. This is a complete biological meltdown.

As in the loss of a single species scenario, if the conservation purposes were too narrowly drafted, it may be that the easement cannot meet the test of Treasury Regulations subsections 1.170A-14(d)(3)(i) and (ii).[197] However, in the complete meltdown scenario it may be that even broader conservation purpose language cannot rescue the easement from termination.[198] If this is the case, perhaps the easement should be terminated based on changed circumstances making it impossible or impractical to carry out.[199]

An alternative to the drastic measure of termination is to amend the easement to protect different features of the property, for example other species, other habitats or, taking a different approach, amend the easement to protect additional purposes such as recreational or open space purposes.[200] As noted earlier, the land trust community almost universally accepts as a standard that any amendment be "neutral to or enhance" the conservation purposes of the conservation easement.[201] This raises an interesting theoretical question. In the situation where

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[194] *See id.* § 1.170A-14(d)(3)(ii).

[195] *See* Walther et al., *supra* note 58, at 686, 688; Jim Moscou, *Beetlemania: How a Tiny Bug Is Ravaging Colorado's Forests*, Newsweek (July 22, 2008), http://www.newsweek.com/2008/07/21/beetlemania.html.

[196] *See* Walther et al., *supra* note 58, at 689.

[197] *See* Treas. Reg. § 1.170A-14(d)(3)(i)–(ii).

[198] *See id.*

[199] *See* Restatement (Third) of Prop.: Servitudes § 7.11 (2000).

[200] *See* Byers & Ponte, *supra* note 105, at 183.

[201] *See id.* at 184; McLaughlin, *supra* note 150, 1063 & n.141; James L. Olmsted, *supra* note 125, at 844.

the original conservation purposes are no longer relevant, how do you measure newly proposed conservation purposes against the "neutral to or enhance" standard? In other words, if all the original conservation purposes are rendered impossible or impractical to carry out, is it still possible to save the conservation easement by amending it, or is this a Catch-22 situation where there is no logical solution?

Just as the land trust community collectively endorses the "neutral to or enhance" standard for amendments to conservation easements, it also accepts the corollary to that proposition, that it is always permissible to make amendments that are more stringent or rigorous than the original provisions.[202] To use the pine beetle example again, if a protected forest were destroyed by pine beetles, the conservation easement could possibly be amended to provide for restoration and remediation efforts to eradicate the pest and to replant the forest.

Although an amendment can be an intermediary solution, in some cases where amendment fails to solve the legal infirmity of a perpetual conservation easement, the easement should be terminated and re-deployed with new purposes matched to the altered landscape. For example, should a conservation easement "crash" after the loss of native species due to invasive species, a perhaps ideal solution would be to terminate the original conservation easement and replace it with a new conservation easement closely tailored to the post-invasion state of the lands to be protected. This would, of course, require either the parties to the original easement to agree to the new easement or new parties with the necessary qualifications to implement the new easement. In some instances, for example if the easement is interpreted as a charitable trust, it may additionally be necessary to seek approval to change the original conservation easement from the state attorney general as representative of the public's interest in the conservation easement.[203]

C. *Cryptic Invasions*

Another critical, yet seldom recognized reason for broadly drafting conservation purposes is the potential for invasive species to remain undetected until it is too late to counter their harmful effects on natural habitat and native species. In *A Sound of Thunder*, the cause of the change in history was initially unknown.[204] It was only after Eckels

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[202] *See* McLaughlin, *supra* note 150, 1063 & n.141.

[203] *See* Nancy A. McLaughlin & Benjamin Machlis, *Amending and Terminating Perpetual Conservation Easements*, PROBATE & PROPERTY, July/Aug. 2009, at 52, 52.

[204] *See supra* Introduction.

found the butterfly on the sole of his boot that the change was understood.[205] Similarly, it is extremely likely that invasive species that intrude upon lands protected by conservation easements will initially be undetected. Indeed, such "cryptic invasions"[206] will in all likelihood remain undetected until the damage they cause is irreversible. The probability that cryptic invasions will remain undetected despite monitoring by the holder of a conservation easement is due to a number of reasons. By way of examples, the invading species may be very small (even to the point of being microscopic), may have camouflage abilities, may be avian (and so is unrecognized in flight), may be nocturnal (and so is unrecognized in daylight), may be seasonal (and so may be absent when monitoring occurs), may burrow, may be aquatic, or may be extremely stealthy. Unfortunately, for the purpose of early detection of invasions, this is but a short list of reasons why an invasion might remain undetected until it becomes irreversible. The challenge of detecting invasions is more fully understood when one considers that the invading species may be bacterial, viral, fungal, algal, aquatic, amphibian, reptilian, avian, insect, or mammalian.[207] And, of course, the list of cryptic invaders must also include plantae such as trees, herbs, bushes, grasses, vines, and ferns.[208] Added to the problem of the complexity of nature and the immense numbers of different species, the land trust staff that is tasked with monitoring any given conservation easement may lack the scientific training to identify cryptic invaders. Indeed, it may be years after a cryptic invasion before the ecosystem that it inhabits crashes, thus bringing the invasion to light based upon the effects of the invader rather than on the identification of the invader itself. By then it is probable that the affected ecosystems are irreparable and the biodiversity they represented is forever lost. Cryptic invasions are of immense importance to the land trust community. If, for example, a contemplated conservation easement acquisition will cover land that is

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[205] *See id.*

[206] "Cryptic invasions" as used in this Article should not be confused with the term "cryptogenic," which in the scientific lexicon refers to species that are not identifiable as either native or introduced. *See* Walther et al., *supra* note 58, at 687.

[207] For a brief but enlightening discussion of invasions by fungal plant parasites, see Richard N. Mack, *Assessing Biotic Invasions in Time and Space: The Second Imperative*, *in* Invasive Alien Species: A New Synthesis, *supra* note 28, at 179, 196–201. *See also id.* at 191 ("Compared with vascular plants, insects are small, often highly mobile, and may be exceedingly cryptic. . . . The mobility of winged insects also frustrates attempts to provide estimates of their spatial distribution because their new range may change daily.").

[208] *See, e.g.*, Kristin Saltonstall, *Cryptic Invasion by a Non-Native Genotype of the Common Reed, Phragmites Australis, into North America*, 99 Proc. Nat'l Acad. Sci. 2445, 2445–48 (2002) (case study of cryptic invasion of plant species).

already subject to a cryptic invasion that will ultimately despoil the conservation purposes bargained for in the price negotiations for a purchased easement, the land trust may very well end up having spent public resources on ecologically devalued property. This and similar scenarios underscore the need for land trusts to have access to experts who can evaluate a property for such invisible invaders. However, even in those instances in which experts have approved a property for a conservation easement on the basis of the absence of cryptic invaders, the initial conservation purposes should be drafted broadly enough to allow the conservation easement to remain in effect and to address the consequences of ecological harm to natural habitat and native species by cryptic invasive species.

V. A Multiplicity of Preserves

A number of law review articles and books have proffered conservation easement drafting strategies with provisions to mitigate the harms caused by global warming and climate change, in particular to mitigate climate change-caused migrations.[209] One solution that has wide currency is the opportunistic approach in which land trusts acquire "a multiplicity of preserves."[210] The background assumption for this strategy is that with enough protected lands, and enough connectivity between them, species would be free to "climate surf" northward, engaging in a sort of biological "habitat hopping" along the way.[211] Presumably, this approach to global warming could proceed in an orderly and largely unassisted fashion. Thus, species *A* would out-migrate from protected habitat *X* to land on the more northerly protected habitat *Y*. In the interim, species *B* would out-migrate from its natural habitat to invade protected habitat *X*. There would be no harm to species *A* from species *B* as species *A* would have already decamped from the now invaded habitat.

As a variation on the multiplicity of preserves theme, it has been proposed that two types of conservation easements could be developed

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[209] *See, e.g.*, Olmsted, *supra* note 125, at 786–809.

[210] *Id.* at 795–96; *see* Brewer, *supra* note 103, at 100–02 (originating and explaining the "multiplicity of preserves" approach to species preservation); *see also* Douglas E. Booth, Land Trusts and Biodiversity 77 (2007) (noting that to be effective in conserving biological diversity, numerous reserves protected by conservation easements and linked by migratory corridors will be necessary to supply replacement species to areas where species are lost due to climatic or other periodic disturbances).

[211] *See* Brewer, *supra* note 103, at 102.

and used to mitigate climate change migrations.[212] One type of easement would be the familiar perpetual easement, which was denoted as a "park" easement in that it would exist in perpetuity as a safe harbor for stable ecosystems.[213] In contrast to park easements, non-perpetual "ark" easements were also proposed.[214] Ark easements would represent strategically placed reserves that could be used as stepping stones for migrating species.[215] Once it was determined that any such ark easement was no longer serving its ark purpose, it would be extinguished and the proceeds would be re-deployed to serve similar conservation purposes on new lands.[216] Unfortunately, despite the flexibility of the "ark" versus "park" model, there can be no guarantee that it will work. Moreover, it is possible that it will even exacerbate species extinctions by allowing more mobile and adaptable species to outpace their natural enemies and to take up residence on habitat islands where they outcompete native species.

A. *Challenges to Habitat Hopping Models*

Based on conversations with conservation biologists and a review of the extensive literature on species extinctions, the habitat hopping solutions such as those proposed in the multiplicity of reserves model and the ark versus park model are unlikely to offer a complete solution to climate-change-caused migrations.[217] One particularly thorny obstacle for the habitat hopping models is the decoupling of biologically essential synchronization of phenological schedules across multiple species. Phenology is the branch of science that addresses the relationship between climate and periodic biological phenomena.[218] Examples of phenological behaviors are the blooming of flowers in spring, annual avian migrations in response to seasonal temperature changes, and small mammals beginning or ending hibernations in response to seasonal

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[212] *See* James L. Olmsted, *Capturing the Value of Appreciated Development Rights on Conservation Easement Termination*, 30 ENVIRONS: ENVTL. L. & POL'Y J. 41, 43–46 (2006).

[213] *Id.* at 43, 46–47.

[214] *Id.* at 44. No tax deductions would be available for the donation of a non-perpetual conservation easement. *See* BREWER, *supra* note 103, at 149.

[215] Olmsted, *supra* note 125, at 802.

[216] Olmsted, *supra* note 212, at 44–46.

[217] *See* BREWER, *supra* note 103, at 109 (discussing how small preserves will rarely protect species from extinction as well as bigger ones can; however, small preserves may have educational value and can also serve as the basis for later acquisitions); Olmsted, *supra* note 125, at 796.

[218] *See* RUSSELL G. FOSTER & LEON KREITZMAN, SEASONS OF LIFE 10 (2009).

changes in temperature and availability of food sources.[219] The synchronies that develop between the phenological schedules of multiple species allow such relationships as predator and prey species and pollinating and pollinated species.[220] Because some species will out-migrate in advance of species that regulate their numbers (for example, a prey species leaves a predator species behind) or are dependent upon them for services (for example, a bee species leaves flowering plants behind), habitat hopping will decouple essential phenological synchronies.[221]

While it is tempting to assume that anthropogenic interventions, such as assisted migrations, might mitigate these problems, it is unlikely that any natural migratory behavior scrambled by the effects of climate change could be manipulated by humans to achieve anything near an orderly and linear migration from easement to easement.[222] Again, the butterfly effect trumps the falling domino effect. Climate-change-induced species migrations can be expected to be disorderly and unsynchronized.[223] The appeal of any of the habitat hopping models is they would allow one species to out-migrate from a given habitat before another species attempts to colonize the same habitat, thus avoiding harmful interactions between invading species and pre-existing species.[224] However, given the challenges to phenological pairings and unpredictable migrations, species preservation through a multiplicity of preserves model or an ark versus park model is a great idea, but there is no indication that these models will work.[225]

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[219] *See id.* at 4–5.

[220] *See id.* at 39, 64–65.

[221] *See* Jay R. Malcolm et al., *Estimated Migration Rates Under Scenarios of Global Climate Change*, 29 J. Biogeography 835, 836 (2002) ("[P]lant migration could lag behind climatic warming, resulting in disequilibria between climate and species distributions, enhanced susceptibility of communities to natural and anthropogenic disturbances and eventual reductions in species diversity."). *See generally* Robin J. Tausch, *Invasive Plants and Climate Change*, U.S. Department Agric. Climate Change Resource Center (May 20, 2008), http://www.fs.fed.us/ccrc/topics/invasive-plants.shtml ("Climate change is exacerbating [changes in the structure and function of landscape scale ecosystems] by altering the amount and seasonal distribution of precipitation [and] seasonal temperature patterns in ways that often favor the invasive species.").

[222] *See* Brewer, *supra* note 103, at 109 (explaining that the hope of conservation corridors—linear connections meant to facilitate interchange of organisms between larger patches of habitat—is to maintain species diversity as well as genetic diversity within a species); Olmsted, *supra* note 125, at 796–97, 799–800.

[223] *See* Olmsted, *supra* note 125, at 789.

[224] *See id.* at 795–96.

[225] *See id.* at 789, 795–96.

B. *"You Say Goodbye and I Say Hello"*

This Article explores the legal consequences of climate-change-caused species migrations on conservation easements. For example, this Article suggests that a narrowly drafted conservation easement may be terminated if a species it was intended to protect out-migrates to cooler climes or is driven to extinction by in-migrations of invasive species on the easement land.[226] To avoid such terminations, this Article argues that it may be possible to rehabilitate a conservation easement by broadening or multiplying its conservation purposes.[227] For example, if the original conservation easement stated that its purpose was to protect species *A* and species *A* out-migrated or was driven to extinction by the invasion of species *B*, the conservation easement could be modified to protect recreational purposes, educational purposes, and/or open space purposes. The precise legal mechanism for doing so would be to amend the easement to add or to modify the conservation purposes. As noted, this may be legally problematic because conservation purposes are the measure of what may be amended, thus amending the conservation purposes may defeat perpetuity. On the other hand, it is generally accepted that any amendment that makes a conservation easement more restrictive will not defeat perpetuity.[228] However, assessing whether any particular amendment that changes the conservation purposes is more restrictive may devolve into a matter of semantics and legal wrangling.

One way that conservation easement drafters can avoid this failure at the outset is to include more than one conservation purpose in the original document.[229] Indeed, some drafters routinely pad conservation easements with multiple conservation purposes and sub-purposes.[230]

This Article also notes the possibility of habitat hopping solutions such as achieving a multiplicity of preserves or utilizing an ark versus park strategy for assisting in the "orderly" migration of species forced from their original habitats by climate change.[231] However, this Article concludes that as currently proposed, such strategies are unlikely to succeed.[232] Before jettisoning such hopeful ideas, there is a potential

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[226] *See* McLaughlin, *supra* note 150, at 424.
[227] *See* Byers & Ponte, *supra* note 105, at 194.
[228] *See id.*
[229] *See id.*
[230] *See id.* at 194, 392.
[231] *See* Brewer, *supra* note 103, at 100–02, 109; Olmsted, *supra* note 125, at 795–96.
[232] *See supra* Part V.A.

alternative view that could maximize the use of habitat hopping models. The land trust community could potentially adopt as "natural" a newly introduced species if it will apparently remain permanently and flourish on land under a conservation easement. The appeal of this approach is its simplicity. As each climate surfing species bids its former habitat goodbye, it is welcomed to its final habitat where it is integrated into the conservation easement monitoring data with the same status as a truly native species.[233] A land trust holding a conservation easement may even go so far as to amend the conservation easement to list the new species as protected.[234]

However this adopting as natural technique would not work for an invasive species that harms an original species or the ecosystem in the conservation easement. As explained above, the standard for amending the conservation easement to protect the new species must be "neutral to or enhancing" with regards to the original conservation purposes.[235] Thus, if the potential new resident behaves as an invasive species and damages other species or habitats that are protected, the conservation easement cannot be amended to protect the new species, although it could arguably be amended to mandate eradication efforts aimed at the new species. Also as discussed earlier, the original conservation purposes could themselves be changed, by amendment, to allow protection of the new species.[236] This, however, leads to the circularity

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[233] *See* BYERS & PONTE, *supra* note 105, at 194. The following comments by internationally known conservation biologist Reed Noss illustrate the tension between differing responses to non-native species. Thus, holders of land trusts must decide if they are going to vigorously eradicate all newcomers to easement land or if they are going to welcome or otherwise "adopt" non-native but non-invasive immigrant species:

> Generally, conservation biologists acknowledge that most non-native species are unlikely to become invasive and do harm. However, as part of a precautionary approach, the best strategy is prevention—keeping non-native species from being introduced intentionally or accidentally by humans. If an introduction occurs, then it is often wise to eradicate the population before it grows so large or widespread that eradication is not feasible. If too late for that, then focus resources on non-native invasive species that are causing the most harm (again, with islands being most vulnerable).
>
> My general advice is that we have to expect natural communities to change over time, with species added and subtracted to/from specific sites, so that easement law and policy must be flexible enough to accommodate such changes.

E-mail from Reed Noss, Ph.D., Dir., Sci. & Planning in Conservation Ecology (SPICE) Lab., Univ. of Cent. Fla., to author (Apr. 7, 2010) (on file with author).

[234] *See* BYERS & PONTE, *supra* note 105, at 183.

[235] McLaughlin, *supra* note 150, at 1072–75, 1090.

[236] *See* McLaughlin, *supra* note 150, at 424.

which was noted earlier as making amendments to the conservation purposes themselves is problematic. In the end analysis, in deploying multiple novel conservation easements, one can never be certain there is not a butterfly on the sole of his boot until, of course, it is too late.

Conclusion

Global warming will cause unpredictable and destabilizing migrations of species, many of which will become invasive in their new biomes.[237] Such invasions will cause extinctions, and extinctions will decrease biodiversity.[238] Without biodiversity we will lose ecological services.[239] We will also lose the complexity and uniqueness of each one of thousands of species that we will drive to extinction. Because land trusts are carrying most of the burden of saving natural lands in the United States and other nations, it falls to the land trust community, and to its oversight institutions such as the Land Trust Alliance,[240] to address the stark reality of climate-change-driven harmful invasions. Indeed, land trusts and the Land Trust Alliance must make it their prime imperative to alter this ecologically fatal trajectory we have embarked upon for the sake of wealth and convenience.

This Article has outlined a set of critical policy choices that demand the attention of the land trust community and of conservation-minded landowners. These policy choices relate to how conservation easements should be drafted to respond to the threat of present and future climate change-caused extinctions that result from non-native invasive species disembarking on easement lands. This Article does not presume to dictate how land trusts should respond to this threat, but it does offer the following sample of drafting strategies and policy directions.

1. To the greatest extent possible, routine monitoring of easement lands should be done under the guidance of scientists.
2. In monitoring conservation easements, both macro-habitats and micro-habitats should be considered. No species should be ignored on the basis of its small size. Likewise, care should be taken to detect microbial, insect, aquatic, avian, nocturnal, camouflaged, or secretive species.

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[237] *See* Olmsted, *supra* note 125, at 787–88.

[238] Malcolm, *supra* note 221, at 835.

[239] *See* Tausch, *supra* note 221.

[240] *Leadership in Land Conservation*, Land Trust Alliance, http://www.landtrustalliance.org/about (last visited Dec. 22, 2010).

3. The results of any monitoring excursion should be compared with the results of previous monitoring excursions to determine the presence of non-native species.
4. One of the following policies should be chosen: (a) all non-native species will be eradicated; (b) only harmful, invasive, non-native species will be eradicated; (c) harmless non-native species will be brought under the protection of the conservation easement; or (d) invasive species will be dealt with on a case-by-case basis in consultations with scientists and governmental entities.
5. If eradication measures are taken, the obligation to implement them must be allocated between conservation easement grantors and grantees.
6. Should invasive species cause harm to the conservation purposes, risk and liability for restoration and remediation must be allocated between grantors and grantees.

This is a brief, broad brush list of drafting and policy options. Hopefully, it will engender future efforts to identify additional global warming and climate change issues and to respond to them in terms of conservation easement drafting and practice.

This Article was inspired by two panel presentations at the 2010 Public Interest Environmental Law Conference held annually at the University of Oregon School of Law in Eugene, Oregon.[241] This conference is the largest and oldest of its kind in the world.[242] Although conservation easement law and practice are but a small part of the conference, the 2010 conference had two panels devoted to drafting conservation easements responsive to global warming and climate change.[243] One panel, which was comprised of lawyers, law professors, and a scientist, focused on how to draft conservation easements that

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[241] *See* Reed F. Noss, Professor of Conservation Biology, Univ. of Cent. Fla.; Jessica Green, Professor, Ctr. for Evolutionary Biology, Univ. of Or.; John Chapman, Professor of Aquatic Invasion Ecology, Or. State Univ.; and James L. Olmsted, Conservation Easement Attorney; Conservation Biology in Managing Perpetually Preserved Lands (Feb. 26, 2010) [hereinafter Panel One]; Nancy A. McLaughlin, Robert W. Swenson Professor of Law, Univ. of Utah Sch. of Law; James L. Olmsted, Conservation Easement Attorney; Jessica Owley Lippman, Assistant Professor, Pace Law Sch.; Adena Rissman, Assistant Professor, Dep't of Forest & Wildlife Ecology, Univ. of Wis.; Conservation Easements and Climate Change (Feb. 26, 2010) [hereinafter Panel Two]; *About the Public Interest Environmental Law Conference*, Univ. Or. Sch. Law, http://www.pielc.org/pages/about.html (last visited Dec. 22, 2010).

[242] *About the Public Interest Environmental Law Conference*, *supra* note 241.

[243] Panel One, *supra* note 241; Panel Two, *supra* note 241.

are responsive to global warming and climate changes and also navigate potential legal obstacles such as the loss of perpetuity.[244] The other panel included three scientists and one lawyer, and discussed how science could contribute to the selection of lands for perpetual protection in the age of global warming.[245] Perhaps the real magic of these two panels was that the lawyers and the scientists were able to mingle and share their ideas about global warming and conservation easements. The world cries out for more such collaborations between scientists and lawyers on the front lines of efforts to mitigate and adapt to global warming and climate change. Hopefully, similar panels and similar interactions can be orchestrated in the future. In the meantime, we should all avoid stepping on butterflies, both metaphorical and real.

[244] *See* Panel Two, *supra* note 241.
[245] *See* Panel One, *supra* note 241.