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The Atlas for the End of the World:

Mapping that Recognizes the Interdependence of People and Conservation

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In 1570 Gilles Coppens de Diest at Antwerp published 53 maps created by Abraham Ortelius under the title Theatrum Orbis Terrarum, considered the "first modern atlas". This is an image of the world map included in that edition.

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On May 20,1570, Abraham Ortelius—book collector and engraver from Antwerp—published the world's first Atlas:[1] the *Theatrum Orbis Terrarum* (The Theater of the World). Lauded for its unprecedented rigor, the *Theatrum* quickly became a best seller. Giving Europeans a definitive outline to what was otherwise just an imaginary new world, the *Theatrum* drew its authority from mapping's implicit association with accuracy and objectivity—in a word, with truth.

But, as history attests, maps are notorious liars.

The Theatrum's frontispiece gives the game away. Five female figures make up the scene: civilized, Christian Europa sits at the top; Africa and Asia seductively decorate the flanks; the naked Americas, holding the cannibal's trophy, reclines in relative darkness below; and a bust of a fifth figure, representing lands not yet discovered, is to Americas' right.

With his maps Ortelius laid bare a world of healthy ecoregions ripe for exploitation. Some 450 years later, at the opposite end of modernity to Ortelius, researchers at Penn Design are building the *Atlas for the End of the World*, a project that underscores the end of *Ortelius'* world—the end of the world as a God-given and unlimited resource for human exploitation and its concomitant myths of progress.[2]

At face value, atlases are just books of maps. In that regard, this one is no different. The maps in this collection are, however, quite specific. They show the difference between the United Nations Convention on Biological Diversity targets for achieving 17 percent global terrestrial area as protected habitat by 2020 and what is actually now protected.[3] This paper describes how the *Atlas for the End of the World* is measuring efforts to meet these targets by 1) mapping protected areas in the ecoregions within world's biodiversity hotspots and calculating how much remains to meet targets, and 2) illustrating the coming conflicts between projected city growth and biologically diverse habitat. The paper concludes with a discussion of the need for mapping that see people and conservation as intertwined.

Biodiversity Hotspots

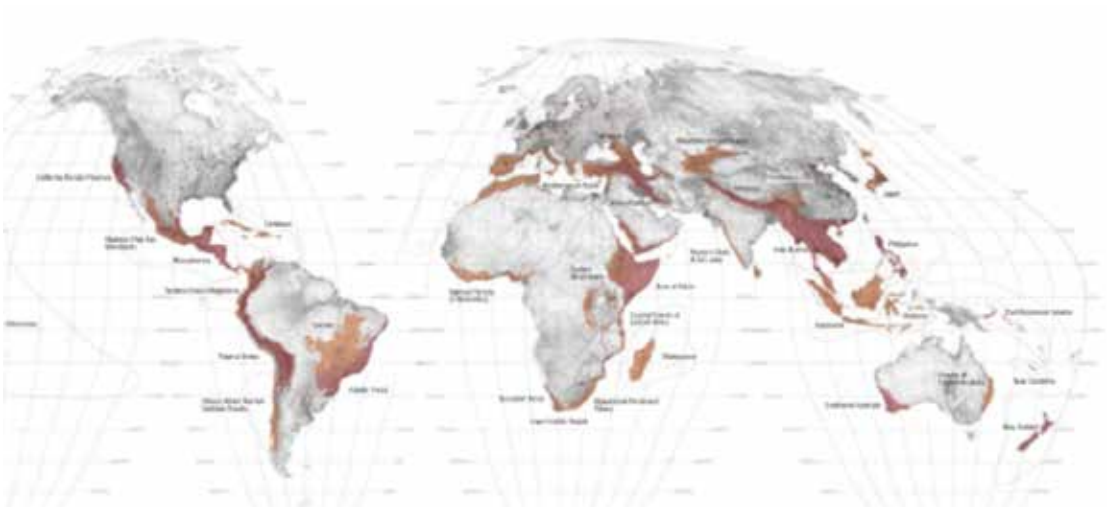
The atlas focuses on the 391 ecoregions (out of 823 ecoregions total worldwide) that comprise the world's 35 biodiversity hotspots. Shown in Figure 1, the so-called hotspots are generally agreed upon by the scientific and conservation communities as the most important biological places on earth. They are also places of exceptional linguistic diversity, suggesting perhaps that the fate of nature and the fate of culture is one and the same. They are also, in more than a few cases, bedeviled by poverty, violence, and corruption.

1 Paul Binding, *Imagined Corners: Exploring the World's First Atlas* (London: Headline Book Publishing, 2003). NB; The first use of the term "Atlas" in a book's title was "Atlas, or Cosmographical Meditations upon the Creation of the Universe and the Universe as Created," by Garardius Mercator. Wilford, J. N. 2000. The Mapmakers (Revised Edition). Vintage Books, New York. 104..

2 On this, even the Catholic Church is now clear: "we have no such right" says Pope Francis. Pope Francis, *Laudato Si: On Care for Our Common Home* (Ignatius Press, 2015), 33.

3 See "Quick Guides for the Aichi Biodiversity Targets," Convention on Biological Diversity, accessed June 1, 2016, https://www.cbd.int/nbsap/training/quick-guides.

Figure 1. The world's 35 biodiversity hotspots are shown in brown.



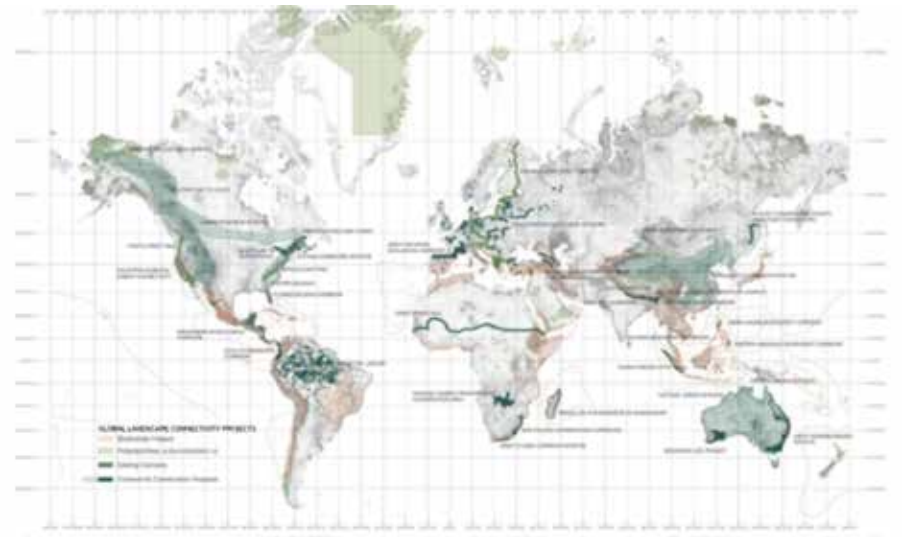
In 2014 (the most recent figures available), 15.4 percent of the world's terrestrial area was protected: that's 20.6 million square kilometers of land distributed across more than 209,000 sites in 235 different countries.4 That leaves only an additional 1.6 percent protected area to satisfy the Convention's 2020 target. While this amount might seem small, 1.6 percent of the earth's terrestrial surface is 2.3 million square kilometers, the equivalent of nearly 700,000 Central Parks—a Central Park stretching 70 times around the world.

Moreover, according to the Convention, that 1.6 percent cannot be just anywhere: the global protected estate must be representative and it must be connected. To be representative, 17 percent of each of the world's 823 ecoregions should be protected. The Atlas primarily audits this goal.

Connectivity is less readily quantifiable. Forming connectivity among all the fragments of protected areas requires weaving new ecological lines through what is typically hostile territory and, in doing so, calls land-use policy and practice into question on a vast scale. Figure 2 shows all the major initiatives to forge large-scale landscape connectivity in the world today. This sort of activity is unprecedented. For the first time in history humans are treating the world as a garden that you have to give back to, not just take from.

4 D. Juffe-Bignoli, et al, *Protected Planet Report 2014* (Cambridge, UK: UNEP-WCMC, 2014), accessed June 1, 2016, http://www.iucn.org/content/protected-planet-report-2014. .

Figure 2. Biodiversity hotspots are shown in tan. Green shows large-scale proposals for connectivity conservation projects.



To understand how the *Atlas* measures and visualizes progress toward the Convention's targets, consider one of the 35 hotspots—the Atlantic Forests, which lie along the coast of Brazil and stretch into Paraguay and Argentina. In this hotspot, only 8 percent is currently protected; it is just under half way to meeting the target. Figure 3 illustrates the progress toward the 17 percent target that the 15 ecoregions comprising the Atlantic Forests hotspot have made.

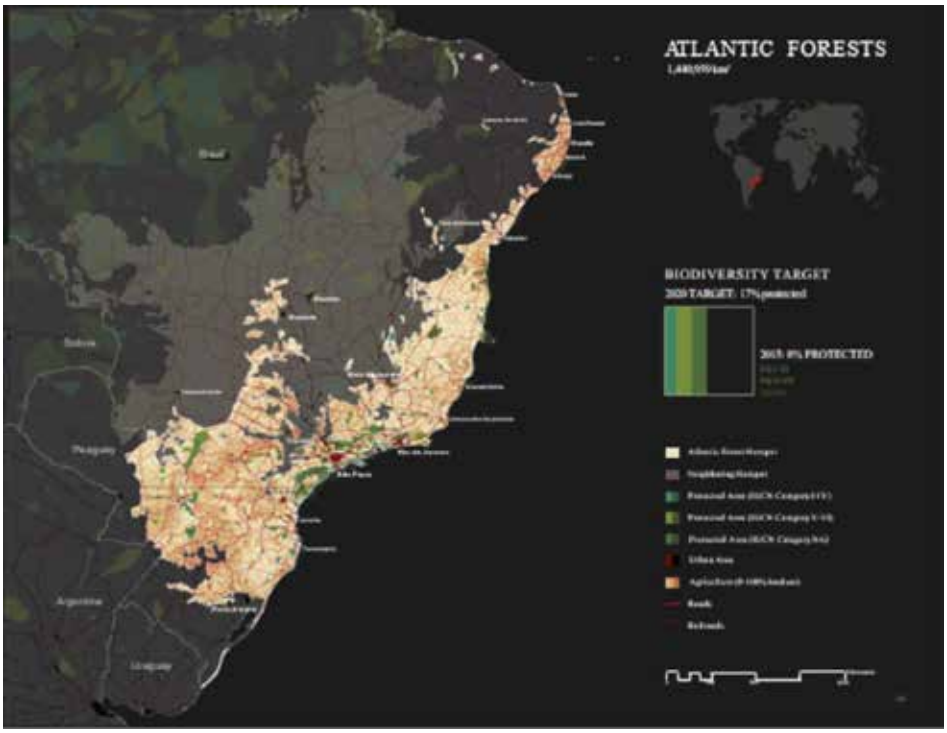


Figure 3. The Atlantic Forests map exemplifies hotspot mapping. The map shows the extent of the hotspot, neighboring hotspots, protected areas, urban and agricultural land uses, and roads and railroads.

The *Atlas* illustrates similar calculations for each of the 391 ecoregions comprising the 35 hotspots, finding that 21 of 35 hotspots currently fall short of the 17 percent protected area target. More specifically, 221 of their 391 ecoregions fall short.

This simple mapping can show any community or nation or NGO exactly how much land they need to protect and—at least in terms of ecoregionalism—where they need to protect it if they wish to meet their obligations under the Convention. Where *exactly* this land should be, and how it should actually function, is a question of great local complexity and a question of design, as is discussed below in "Global Policy and Local Design."

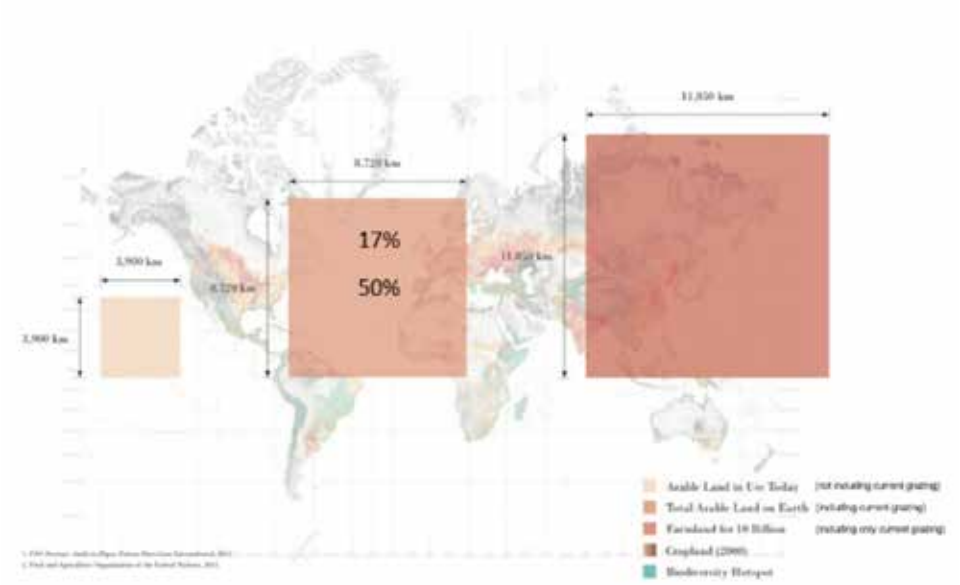
The big issue the Atlas highlights is the global tension between food production and biodiversity, as illustrated in Figured 4. The three squares represent, from left to right,

a. the world's current crop land,

b. the world's arable land (the world's current crop land *plus* current grazing land *plus* the world's further supply of arable land, a total of 50 percent of the earth's ice-free surface area), and

c. the problem: the foodbowl necessary to feed 10 billion people living at an average American standard. Ten billion is a conservative estimate of world population that lies within the UN's forecast of between 9.5 and 13.3 billion in 2100.

Figure 4. The world's current crop land, the world's arable land, and the foodbowl needed to feed the 10 billion people expected to populate the Earth by year 2100.



As noted, the middle square, (b), represents 50 percent of the earth's ice-free surface area; of the remaining 50 percent, 33 percent is desert—land by definition not suited to forestry or biodiversity. That leaves 17 percent for other uses.5 A world with 10 billion people who consume like average Americans—people who shop in supermarkets and eat more or less whatever they want whenever they want, people with an average food footprint of 1.4 hectares each—would require 93 percent of the earth's ice-free terrestrial surface to be used for food production.

5 While this is precisely the amount demanded for biodiversity by the Convention, this is not, so far as I know, how they arrived at this figure.

The world's total arable land—the middle square, (b)—will only support 5.4 billion average Americans. With 10 billion people with an average food footprint of 1.4 hectares each, not only would all the world's arable land be used for agriculture but so too would the world's deserts and then some, leaving a mere 7 percent of the earth's terrestrial surface for biodiversity. We would be left with essentially a mountainous zoo in the midst of a global monoculture of corn and cattle, hooked up to desalination plants.

These proportions of land-use will change when global population drops, as it probably will in the 22nd century due to socio-economic influences associated with urbanization. These projections could change, too, if the bulk of food production shifted to the oceans, and/or if meat could be produced independently of ruminants entirely. Then, ecological restoration—or what the Breakthrough Institute has called "decoupling"—could take place on a scale commensurate with that which is needed to partially correct the Earth System's current imbalance. The trick will be to get through this century's incredibly tight ecological bottlenecks and come out the other end with some ecosystems—preferably the hotspots—partially intact.

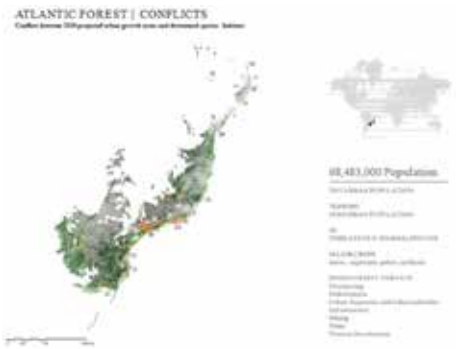
Cities within Hotspots

Published two years after Ortelius' Theatrum in 1572 and conceived as a companion to it, was the Civitates Orbis Terrarum a six-volume Atlas of 450 (almost entirely European) cities edited by George Braum with engravings by Frans Hogenberg. The Civitates is a taxonomy of medieval and renaissance urbanism—a world where cities sat in seemingly idyllic agrarian landscapes, huddled around their cathedrals and their waterways. A world without what we pejoratively now refer to as sprawl.

In reference to the Civitates, the Atlas presents a new collection of cities, 420 in total and all of them in the world's hotspots. The Atlas locates each city on a "Conflict Map" and then zooms in to superimpose each city's 2030 growth trajectory (as per Karen Seto's work at Yale6) on threatened species mapping (from the International Union for the Conservation of Nature (IUCN) Red List). This identifies the flashpoints between future urban growth and biodiversity.

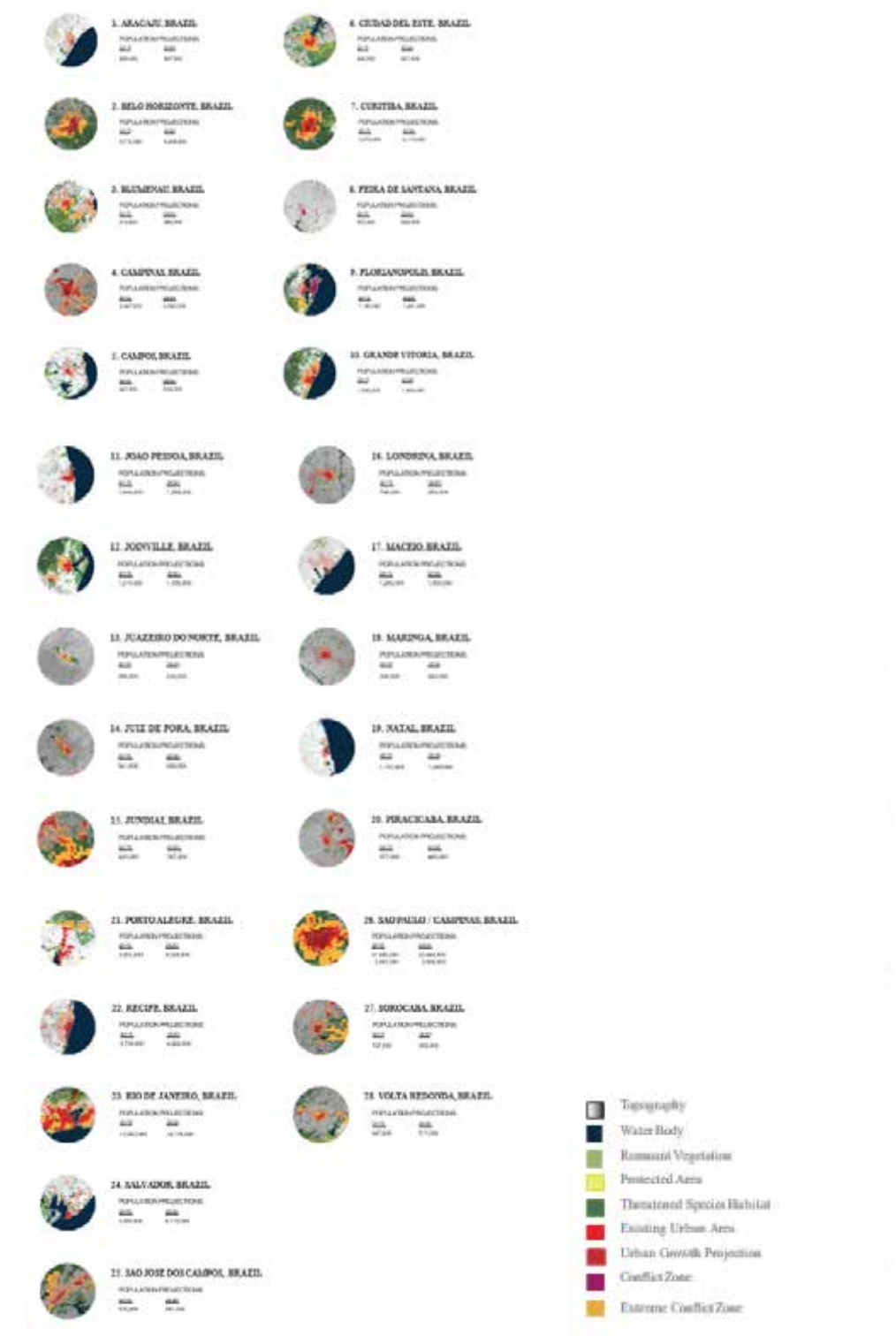
To illustrate, consider in the Atlantic Forests hotspot. Figure 5 is the Atlantic Forests Conflict Map, which shows the major cities (over 300,000 people) and their infrastructure in this hotspot. Figure 6 shows each city within the hotspot, with yellow indicating direct conflict between urban growth and biodiversity. As can be seen ,19 of these 28 cities are likely to expand into remnant habitat with high biodiversity value.

Figure 5. Atlantic Forest Conflict Map.



6 Karen C. Seto, Burak Güneralp, and Lucy R. Hutyra, "Global Forecasts of Urban Expansion to 2030 and Direct Impacts on Biodiversity and Carbon Pools," *Proceedings of the National Academy of Science of the United States* 109, no. 40 (2012).: 16083-16088.

Figure 6. Cities within the Atlantic Forest hotspot.



The Atlantic Forests hotspot exemplifies the problem that well over half of the 420 hotspot cities face. To be precise, 244 of them are on a collision course with unique and irreplaceable biodiversity.

A cursory analysis suggests that most of these cities in the world's hotspots that are on collision courses with biodiversity don't have any semblance of what we would refer to as whole-of-city urban planning. The lack of planning at the city scale is also evident at the national scale; *almost all* the nations in whose jurisdiction the world's hotspots lie do not have national land-use plans incorporating biodiversity. Under the Convention on Biological Diversity, each nation does have to have a *National Biodiversity Strategy and Action Plan* but these tend to be wordy, platitudinous reports and many are out of date.

Additionally, landscape architects and planners are conspicuously absent in these territories. By mapping both the ecoregions and the cities within them, the Altas aims to draw attention to the frontiers of the sixth extinction and entreat planners and landscape architects to help address it.

Global Policy and Local Design

As alluded to earlier, global policy settings and the satellite's reductive view of the world are far removed from the real complexity of the things they hold in their pixelated gaze.

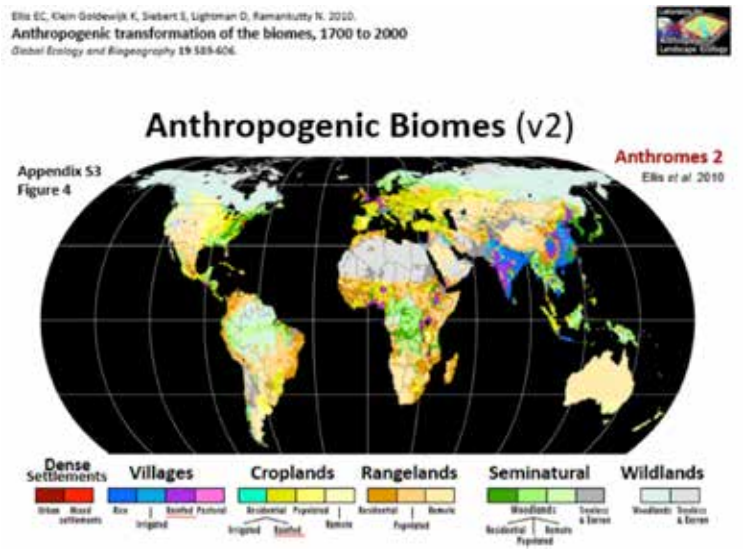
No landscape is ever simple—protected areas in hotspots least of all. Demeaned as "fortress conservation" and "paper parks," protected areas are criticized for reducing the world to a global battle ground between culture and nature, for reinforcing nature as an exotic victim, and for simply turning noble savages into noble park rangers. For their critics, protected areas are neocolonialism writ large and green.

Protected areas manifest tensions between the global and the local, between anthropology and biology, between the developed and the developing world, and between the state and its subjects. It is this that caused Nelson Mandela to remark: "I see no future for [protected areas] unless they address the needs of communities as equal partners in their development."7

Maps that see people and conservation as intertwined are necessary to overcome these criticisms. These are called anthromes: maps that classify landscapes as novel ecologies according to their various forms of anthropogenic modification.8 The University of Maryland geographer Erle Ellis argues that anthrome mapping signifies "a wholesale rethinking of ecological science and conservation that moves away from humans as recent destroyers of pristine nature and towards humanity's role as sustained and permanent stewards of the biosphere."

7 ibid, xix.
8 See "Anthromes," Laboratory for Anthropogenic Landscape Ecology, accessed June 1, 2016, http://ecotope.org/anthromes/.

Figure 7. This map illustrates the athropogenic transformation of the biomes, 1700 to 2000. Source: E.C. Ellis, Klein Goldewijk, S. Siebert, D. Lightman, and N. Ramankutty, "Anthropogenic Transformation of the Biome, 1700 to 2000," Global Ecology and Biogeography 19: 589-606, 2010.



But the allegory of stewardship that Ellis invokes is too pastoral for a world where people are now seriously considering modifying the chemical composition of the atmosphere and the oceans. In this new world, stewardship becomes "geoengineering"—the intentional modification of the Earth System. The geoengineering sensibility is being championed by the Breakthrough Institute, which, to considerable fanfair (and criticism), launched its so-called "Eco-modernist manifesto" in 2015.9 In the great American tradition of spinning crisis into opportunity, the manifesto envisages and promotes the conscious creation of what it refers to as the "good Anthropocene." This, the Breakthrough Institute argues, will emerge some time this century through a process of "decoupling" humanity's negative impacts from the environment via the agency of ever-advancing technology. Humans, they declare, will "have the opportunity to re-wild and re-green the Earth—even as developing countries achieve modern living standards, and material poverty ends."10

For them—and this is a key point—this lovely future is just an intensification of historical processes already well underway. As we slide inexorably into the oblivion of climate change, the techno-utopianism of the eco-modernists is somewhat refreshing. But it's also alarmingly ahistorical and oddly naïve.

For critics such as the Australian Professor of Ethics Clive Hamilton, the eco-modernists—along with their geoengineers—are just promoting scaled-up versions of the very attitudes and practices that created this crisis in the first place.[11] For Hamilton, the Anthropocene is not just an engineering problem, nor is it just a continuation of history: it's a Copernican revolution or, as he puts it, a "rupture" requiring a radical and fundamental revision of what it means to be human.

The question for eco-modernism's critics must be: If we reject both "the ecological" and "the modern" and the way the eco-modernists are putting the two together, then what can we imagine in their stead? As Frederic Jamieson once quipped: "it's easier to imagine the end of the world than it is the end of capitalism."

9 "An Ecomodernist Manifesto," An Ecomodernist Manifesto, accessed June 1, 2016, http://www.ecomodernism.org/manifesto-english/.
10 ibid.
11 C. Hamilton, "The Anthropocene as Rupture," *The Anthropocene Review* 1-14 (2016).

In terms of the ecomodernist debates, Peter Karieva, former Chief Scientist for the Nature Conservancy, is provocative in that he believes capitalism and environmentalism can work this out. Karieva sees the contemporary landscape as a design and planning problem: "...fences, limits, and faraway places only a few can actually experience is a losing proposition,"[12] he writes. Instead, "[c]onservation should seek to support and inform the right kind of development—development by design, done with the importance of nature to thriving economies, foremost in mind."[13] Riling the deep ecologists, he says that "[i]nstead of scolding capitalism, conservationists should partner with corporations in a science-based effort to integrate the value of nature's benefits into their operations and cultures. Instead of pursuing the protection of biodiversity for biodiversity's sake, a new conservation should seek to enhance those natural systems that benefit the widest number of people, especially the poor."[14]

As with any historical reworking of the concept of nature (and that is what the Anthropocene is really about) the reorganization of land-use boundaries follows, and uneven power relations are inscribed. Conservation cannot, as its critics point out, escape accountability just by virtue of its valorization of "nature;" however, if a neo-liberal conservation landscape has a lower species extinction rate than its extractive predecessor, then surely a neo-Marxist, post-colonial critique of "conservation as development" is not so straightforward.[15]

So as we overlook the neo-liberal, eco-modernist conservation landscape, we must ask: Where are the poor? Where, in the image of our rationally planned, techno-Gaian future, are all those that modernity has thus far so thoroughly failed? What exactly are they doing? What will they do? Can the new global peasantry—the billion or more who won't make it into the "age of urbanization"—be put to work on projects of global ecological restoration, while robots work the farms?

For some, Karieva is dancing with the neo-liberal devil and abandoning conservation's most sacred sites—protected areas. But for landscape architects and planners, Karieva is opening the door through which planners can collaborate with conservation biologists, with the NGOs *and with local communities* to help design and plan more diverse and productive landscapes. This is not the end of the world at all—it's just the beginning of the Anthropocene.

ACKNOWLEDGEMENTS

This research was conducted in association with Clare Hoch and Chieh Huang..

12 ibid.
13 ibid.
14 Peter Kareiva, Michelle Marvier, and Robert Lalasz, "Conservation in the Anthropocene: Beyond Solitude and Fragility," *The Breakthrough*, no. 2 (2012), accessed September 25, 2015, http://thebreakthrough.org/index.php/journal/past-issues/issue-2/conservation-in-the-anthropocene.
15 P. West, *Conservation Is Our Government Now: The Politics of Ecology in Papua New Guinea* (Durham, NC: Duke University Press, 2006), cited in Bram Büscher, Wolfram Dressler, and Robert Fletcher, *NatureTM Inc.: Environmental Conservation in the Neoliberal Age* (Tucson: University of Arizona Press, 2014), 13.