Conserving a Used Planet: Embracing Our History as Transformers of Earth

BY ERLE ELLIS

Photo: Eric Vernier

Humanity and the planet are in crisis, the result of industrial societies that are destroying Earth's ecology at an accelerating pace. The only hope is to end our reliance on advanced technologies and go back to earlier ways of living in harmony with natural ecosystems.

That's the typical narrative of environmentalism — one of crisis and renunciation. But is it truly the best hope for the biosphere? Is it even historically accurate?

Not according to a *global assessment of human use of land* across the Holocene

that I co-authored. The most recent evidence indicates that humans have been transforming the terrestrial biosphere at globally significant levels not just for the past century or so — but for more than 3,000 years. And that human use of land per capita has been *declining* over most, if not all, of that period.

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It turns out that focusing on the dramatic environmental changes of recent decades overlooks the historical role of humans as sustained shapers and stewards of the biosphere. Instead of adopting a narrative of crisis and renunciation, those who care about people and nature need to take the long view back to map a better way forward — especially now, when global urbanization presents us with new opportunities for significant conservation.

Of course, industrial processes are indeed causing massive changes in the Earth system. But understanding how our species reshaped the terrestrial biosphere for millennia is no less massive or important. Recent, spatially explicit global reconstructions of human populations and their use of land across the Holocene now enable us to quantitatively assess the long-term dynamics of human transformation for the first time (Fig. 1).

These reconstructions cannot yet be conclusively validated against empirical data at global scale. Nevertheless, by comparing them against what we know from archaeology, paleoecology, geography and environmental history, we can gain key insights into the mechanisms driving long-term human transformation of ecosystems, along with the consequences of these dynamics for the both the present and future state of the planet.

The overall record? We have been making substantial alterations to a wide range of habitats across many continents for a long, long time.

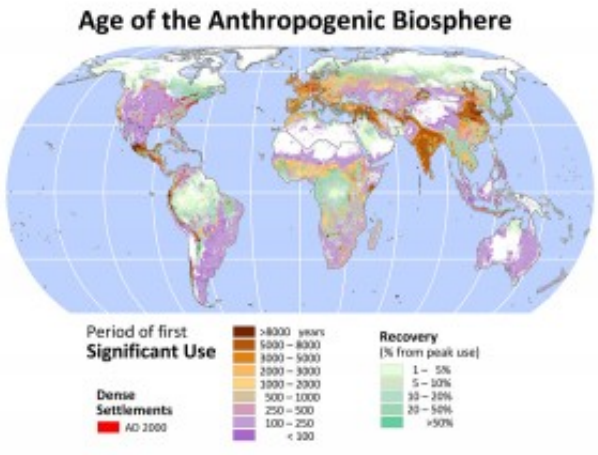

Fig. 1: Age of the Anthropogenic Biosphere

Photo: John Shape

Motorists en route, on a freeway in Southern California.

By as early as 5,000 years ago, for instance, ecosystems across more than 20% of Europe and Asia had already been transformed — i.e., had their biodiversity and ecosystem processes significantly altered — by intensive human use of land. The same proportion of Earth's temperate woodlands had also been transformed by this time. More than 1,000 years ago, tropical woodlands and savannas had been altered at similar levels and intensity, followed shortly by grasslands and shrublands. In fact, many large areas of Earth's land not presently used by humans at high levels are recovering from

intensive land use in earlier periods, including Southeast Asia after the fall of Angkor and the collapse of empires in the Americas both before and after Columbus.

But how could so few humans (about 80 million in 1,000 BC) perform such massive changes upon the land?

It's because humans — like other species — invest no more effort than necessary to sustain themselves. We adopt more productive land-use systems only in response to the demands of growing populations and other social and/or economic pressures — a sustained adaptive process called land-use intensification (Fig. 2).

These pressures — and land users' intensification responses — exist even when population densities are low, such as when increased food demands lead hunters to adopt more effective weapons or hunting strategies, or when farmers must till the soil ever more frequently instead of allowing fields to recover by lengthy periods of fallow.

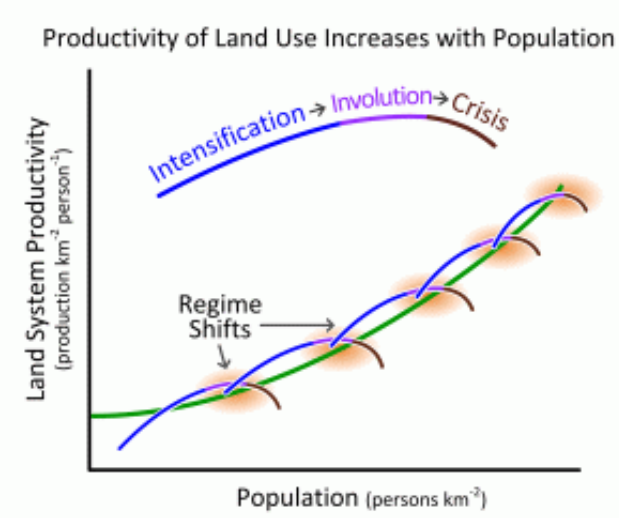

Fig. 2: Productivity of Land Use Increases with Population

Land-use intensification began early, long before the Holocene. Prehistoric hunter-gatherers depended on a growing array of pre- and proto- agricultural practices to support larger populations on the same land, including dietary broadening (eating more species once preferred megafauna were rare or driven extinct); burning vegetation to enhance hunting and foraging success (ecosystem engineering); and the propagation of useful species.

While these practices were much less productive than the agricultural technologies that came later, they still enabled human populations to grow far beyond the capacity of unaltered ecosystems to support them. (Intensification

generally causes land productivity to increase with population, although productivity increases are rarely smooth and continuous, but instead track a complex succession of land system regime shifts and adoptions of productive land-use systems.)

As Earth's human populations grew, so did the areas of intensification and resource exploitation. More intensive land-use practices sustained them or populations migrated to areas with less intensive use (extensification), including uninhabited wildlands. By early Holocene, hunter-gatherer populations were established across the Earth, and required early land-use intensification processes to survive and to grow, living mostly within ecosystems that had already been transformed by their ancestors to enhance nature's productivity.

The rest is history. Agricultural technologies emerged across the Earth in as many as 24 independent centers of domestication. Those populations that adopted agricultural land-use systems grew more rapidly than those of hunter-gatherers, ultimately replacing them across Earth's most productive lands. Intensification continued, with shifting cultivation giving way to continuous cropping, the plow, irrigation, manuring and other increasingly productive techniques.

The overall shifts first supported densely populated villages and eventually supplied food surpluses to growing urban populations. The growing demands of urban populations compelled ever larger scales of farming operations, trading systems and technological institutions, eventually leading to the high-yielding "green revolution" land-use systems and globalized commodity networks of today, sustained by massive amounts of fossil energy and other industrial inputs.

But have we reached the stage where intensification is now the way forward for conserving the planet, not just transforming it?

Today, high-yielding industrial agricultural systems have made it possible for the majority of humanity to live in urban areas for the first time. As cities

grow and agriculture continues to intensify, migration to cities is depopulating the rural landscapes of many regions, leaving lands less suitable for industrial-scale agricultural abandoned. In their place, forests are recovering in regions where economics and governance support it, such as the United States, Europe and even in many regions of China.

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As we enter the 21st century, agricultural productivity is increasing. Global populations are leveling off. There is growing interest around the world in sustaining biodiversity in both native and recovering habitats. The big question is: how can we harness these long-term trends to enable both humanity and nature to thrive in the Anthropocene?

The answer may come from history. As Winston Churchill said: "The farther backward you can look, the farther forward you are likely to see."

The idea that advanced technologies are inherently harmful must be replaced by the reality that these technologies have always been the means by which our species has survived and prospered. This is not to say that all technologies are good or that technological dependence is without issue. A host of problems emerges from almost every technology we use. Greenhouse gas pollution could derail all prospects for a desirable future.

Yet with vigilant efforts, governance and civic empowerment, great progress can and has been made in reducing and managing these problems. Most importantly for humanity, there is no going back. Earth cannot sustain 7 billion hunter-gatherers or even 7 billion farmers. We must make the best of the planet we have made and the ways we have adapted to live on it.

Since prehistory, ever more advanced and intensive land-use technologies have been used to gain our sustenance from the Earth. In the process, our ancestors created the used but still thriving human biosphere we now depend on — the urban, agricultural and forested anthropogenic biomes (anthromes) that now cover more than three quarters of Earth's ice-free land. Almost 40% of Earth's land is now used for agriculture and settlements and less than 25% is left wild.

Longsheng rice terrace mountain.

Yet the view from any airplane will show that human landscapes are rarely either fully used or fully wild. Anthromes are complex mosaics of agriculture and settlements interlaced with patches of remnant recovering, and more lightly used novel ecosystems.

As populations leave for the city and agriculture intensifies, lands are being left to recover all over the world. The prospects for a global expansion in novel ecosystems are very real, offering an *unprecedented planetary opportunity* to restore Earth's ecological heritage.

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Can these trends be accelerated? Can multifunctional landscape-management strategies increase land productivity while restoring native biodiversity and ecosystem functions? Can local stakeholders be empowered to succeed in these complex and sometimes contradictory strategies? Can conservation efforts in working landscapes be protected against the dynamic and powerful demands of global markets? Can smaller habitats be managed to sustain natural processes at larger scales?

One thing is sure. To create the Earth our descendants will be proud of, we must first embrace our history and identity — as continuous shapers and stewards of the biosphere.

Figure Legends

Fig 1: Historical reconstruction of global land use history, highlighting the time period of first significant land use and areas now in recovery from peak land use. Source: *Ellis et al. 2013*.

Fig. 2: A general model of increasing land use productivity (intensification) with population (After Fig 3 in Ellis et al. 2013). Arcs depict individual land-use systems with three phases: Intensification (technologies enable productivity to increase faster than population), Involution (technology-driven productivity increases become exhausted, such that only net increases in labor or other costly inputs enable increases in production), and Crisis (all capacity to enhance land productivity is exhausted and food production cannot keep up with increasing populations). Regime shifts drive changes from less to more productive land systems. Green line highlights general trend toward increasing productivity with population. Source: *Ellis et al. 2013*.

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