

***Citation:***

Ellis, E. C. 2015. Too big for nature. Pages 24-31 in B. A. Minteer and S. J. Pyne, editors. *After Preservation: Saving American Nature in the Age of Humans*. University of Chicago Press, Chicago.

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# Too Big for Nature

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Seven billion people. Two billion more on the way. Intensifying agriculture. Accelerating urbanization. Increasing resource use per person. Atmosphere, climate, and oceans altered by industrial pollution. The ecology of an entire planet transformed by human action.

This is the new normal. We live in the Anthropocene, a new period of Earth's history defined by human influences so profound and pervasive that they are writing a new global record in rock. Humanity has emerged as a global force of nature. The earth will never be the same.

This stark assessment strikes different people in different ways. To some, the idea of humanity playing such a major role in planetary affairs is nothing more than hubris. To others, it marks defeat; as humanity overwhelms the balance of nature societal collapse must surely follow. And to others, the concept is a call to arms—it might still be possible to pull humanity back from the brink and return to harmony with nature. There are other views. Regardless of one's interpretation however, scientific consensus is growing in support of formal recognition of the Anthropocene as a new epoch of geologic time.

We cannot know how long the Anthropocene might last. But implicit in the act of recognizing the Anthropocene is the proposition that it might well endure for thousands of years or longer. Here I approach nature conservation from this Anthropocene perspective, accepting that humanity has already reshaped Earth's

ecology and might continue to do so for millennia to come. In so doing, I propose that by embracing the Anthropocene we might enable engagements with nature that yield more desirable outcomes for both humanity and nonhuman nature over the long-term.

The first step in embracing the Anthropocene is to grasp that there is nothing new about human alteration of Earth's ecology. As the most abundant large mammal in history, humans, like other abundant species, have outsized ecological impacts owing merely to our large populations. Yet this fact does not begin to explain how our species came to alter the ecology of an entire planet. The first key to explaining this is that humans are a niche-constructing species. Like the beaver, we engineer ecosystems to sustain our populations. Even more important however, is our species' unrivaled ability to transmit these and other social-technological capabilities across generational time. The human niche has been expanded far beyond anything that unaltered nature could provide, and this has been accomplished through culturally transmitted capabilities that evolve more rapidly than possible by biological evolution.

More than 200,000 years ago, our predecessors used tools of stone and fire to extract more sustenance from landscapes than would ever be possible without these technologies. Our species took this much further. Over generations, our ancestors learned to make use of a far broader spectrum of species after preferred megafauna like the woolly mammoth became rare or extinct, to extract more nutrients from them by cooking and grinding, to burn woodlands to enhance hunting and foraging success, and to propagate the most useful species. Thousands of years before the advent of agriculture, hunter-gatherer societies had already become well established across the earth and depended on increasingly sophisticated social-technological strategies to sustain growing populations in landscapes long ago transformed by their ancestors.

These processes of cultural evolution and population growth

continued to accelerate with the rise of agriculture, urbanization, and industrialization. As toolmakers, burners, propagators, farmers, and urbanites, we have increasingly shaped the ecologies that sustain us. Through millennia of technological innovations, social learning, and ecosystem transformation we have expanded and enhanced the human niche across the planet toward the industrial technologies, urban settlements, and global networks of exchange that now sustain most of humanity. In this continual process of niche construction we became what we are today, the engineers and managers of a planet transformed by the artificial ecosystems required to sustain us. And like our ancestors before us, there is no other way for us to live on this planet.

It is a very good thing that our ancestors developed ever more efficient ways to sustain growing populations on the same old land. We wouldn't be here otherwise. And there is no going back. It would be impossible to sustain seven billion people by hunting and gathering. The same is true even for traditional organic farming. Human populations now depend on advanced technologies like synthetic nitrogen fertilizer that have increased land productivity manyfold over the agricultural systems of even half a century ago. Population growth expected in coming decades will only increase our dependence on advances in technology.

In the Anthropocene, the biggest problem with nature is that we've outgrown it. There is no longer any way to sustain human populations on untransformed ecosystems. To embrace the Anthropocene, we must stop imagining ourselves nurtured by a nonhuman nature and accept the reality that it is only by transforming nature that we survive and thrive. The fate of both humanity and nonhuman nature does not depend on sustaining natural ecosystems but on the most proactive human reshaping of nature ever in history.

How can nature be conserved by such a massive transformation of ecosystems? The answer lies in embracing the role of

humanity as permanent shapers and stewards of Earth's ecology. To conserve nature in the Anthropocene, the ecosystems engineered to sustain us must be engaged to the fullest. It is only by increasing the productivity of engineered ecosystems that we gain the ability to leave room for nature. To demand less from our agriculture or our settlements is to demand more from the rest of Earth's ecology. The only hope of conserving any semblance of a wild nature is to offer it the luxury of not serving us.

More than 40 percent of Earth's land already serves humanity directly in the form of agriculture and settlements. Human populations could continue to thrive using just these lands—or even a smaller area. But either outcome will require increasing agricultural productivity and settlement density over the long-term together with more effective sharing of these across society as a whole. While success in this effort is by no means guaranteed and will depend on major sustained economic and social investments, it is certainly within reach. Land can be spared for nature in proportion to how productive engineered ecosystems can be made.

Some large areas still remain unused, especially in the colder and drier regions of the biosphere. It might still be possible to protect their native ecological patterns. Yet climate is changing rapidly. To keep up, species must migrate and colonize new landscapes. Not to allow this will ensure extinction. Nature cannot be locked down. Even in some of the most pristine habitats remaining on Earth, conservation must embrace a changing nature. Anthropocene-aware conservation assists nature in changing—as nature must now change faster than ever.

Sustaining a nature that moves will also require the comprehensive restructuring of the working landscapes that sustain us. Human use of land for agriculture and settlements is rarely complete, leaving fragments of habitat embedded within mosaics of used and unused lands. These remnant, recovering, and less impacted habitats now cover more than one-third of Earth's land and are scattered across Earth's most productive regions. To the

extent that these novel habitats and ecosystems can be managed, restored, and connected together to sustain species, they offer perhaps the greatest opportunity of all to sustain biodiversity across the Anthropocene. To make this possible and to facilitate species migration toward the poles, working landscapes must be reengineered at continental scales to offer pathways across the planet for species to move—across and through our fields, our fences, our roads, and our cities. Such work has already begun. And for species too slow to keep up with the Anthropocene, the effort to propagate and transplant them is also well under way.

We must never forget that ecosystem engineering comes naturally to us. Most of humanity transitioned long ago to the hard work of cultivating domesticated species for food. The only significant wild foods remaining in human diets are now harvested from the sea—and with industrial scale technologies, the transition to farmed seafood is moving quickly. While agriculture and industry produce massive global environmental consequences, going back to hunting and gathering or even to traditional technologies would make these massively greater—more land would immediately be brought under the plow. With the giant scale of the human enterprise, to use woodlands for fuel or to absorb our carbon pollution, to use wetlands to purify water, or to demand any other service from an ecosystem is to tangle with the forces of engineering. When we demand that ecosystems service us, we should expect that engineering them could ultimately deliver more. More fast growing trees, engineered wetlands, and restructured landscapes. The result will be a nature shaped more by us, not the other way around.

To conserve any essence of wild nature in the Anthropocene, it will be necessary to consider two natures: one transformed to service us and another that we cannot or will not create or use. To make room for wildness means to engineer the spaces in which we may leave nature alone. By this effort we return to the classic spiritual values of nature conservation—but with a twist. To love nature in the Anthropocene it will be necessary

to love an artificial nature, to cherish artificial wilderness along with artificial evolution. Even the ecologies that we work hardest to conserve already feel our touch and are changing fast—in response to our ancestors, cultures, climates, domesticates, weeds, and our machines. To commune now with nature is to become one with all of this.

It is far too late to hold human influences back. Already, our presence is everywhere. To engineer space for nature will demand the most concerted efforts to reduce and remediate the pollution, climate change, exotic species, and other influences that issue from our engineered existence. Yet we can be sure that this cannot ever be accomplished completely. Human influence in the Anthropocene is everywhere and permanent.

In the Anthropocene, humans do not disturb nature. We reshape it. The age-old view of humans as destroyers of nature no longer holds. The Anthropocene demands that we view humanity in the act of creating and sustaining a new nature—and one that will endure in geologic time. Clearly, such a view challenges the proposition that pristine nature still exists and can be conserved. But more importantly, it also challenges the view that by transforming natural ecosystems, we humans are undermining the “life support systems” that sustain us. To those who argue that without ending human transformation of Earth’s ecology, humanity must perish along with the rest of nonhuman nature, I offer the opposite. Only to the extent that humanity is able to engineer, design, and conserve nature more actively than ever before will humanity or nonhuman nature thrive in the Anthropocene. The question now is not how nature can continue to sustain humanity, but how humanity can continue to sustain nature.

To embrace the Anthropocene is to become comfortable within the used and crowded planet we have created. In doing so, it is necessary to believe in the possibility that the planet of tomorrow will be no less wondrous to live in than the one we live in today, alive with the species we treasure and also those



Figure 4. The nature that sustains us is a nature reshaped by humanity. Water gathered at the well comes ultimately from nature, but only reaches us through the social-technological efforts of our ancestors. To conserve nature, we must reshape it to sustain us more effectively. Photo credit: Erle Ellis (in Kathmandu, Nepal).

that we don't, and in which the richness of human existence has improved, not declined. Less desirable and even catastrophic futures also exist. It may not be possible for today's human systems and ecologies to be moved by us toward better ends. But let us embrace the challenge to gain mastery over human engagement with the earth. To sustain what has been left to us—the social-ecological legacies of our ancestors—while continuing to discover new ways of living even more desirable than those before and that give us hope, pleasure, sustenance, and freedom in the Anthropocene.

That one species has managed to transform an entire planet is unprecedented. To imagine two billion more of us with even greater living standards than today might seem impossible. The earth is finite, and we have already reshaped most of it. To me this represents the ultimate challenge. We must turn our efforts toward imagining and shaping a future Earth outside of any

human experience. In so doing, we must also embrace the reality that much of what we desire must be allowed to emerge by processes beyond our control. Evolution must continue. The nature that we cannot create is growing ever scarcer and more priceless. To create the pristine has always been impossible—and now to preserve it, even more.