

Deep Time: Its Meaning and Moral Implications

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Abstract

Responding to the normative query “What ought we to do?” depends on what the world and we are, and how the world and we came to be. The latter claim relates moral appraisal to co-evolution, the former to ecological dynamics. The interminable duration of deep time subsumes both evolutionary and ecological emergence. Currently, the rate of habitat destruction and its attendant mass extinction is accelerating, and threatens human existence more than its contributor, global warming. This mass extinction can be mitigated, but not stopped. What does this mean for future generations of people, given our direct dependence on ecosystem functions? How will humans face not just incurring the loss of an economic way of life, but likely losing forever the *possibility* of that reality? An ethos based on “radical hope” when conjoined to deep time may help us not only assuage despair, but also flourish with values, stories, and traditions better adapted to the reality of our ecological and moral existence.

Introduction

How possibly can the structure and quality of deep geologic time have any bearing on human morality as the title of this paper contends? After all, moral sentiments are embedded in human belief systems that on the whole are independent of the Earth’s history. Even if moral sensibilities emanate from human nature¹ or from embodied minds², they are indisputably unrelated to the findings of those natural sciences that scrutinize landscapes and biota, such as paleontology, historical geology, geomorphology, evolutionary biology, ecology, and paleoecology.

But is it that simple? Are the spontaneities of wild Nature irrelevant to human ideals? Do the prescriptive judgments of people actually rise above or lie beyond the accounts of the Earth’s past and the workings of its ecosphere? Or is the ethical bearing of humans irrevocably rooted to the soil and biology of the deep past? After all, we are made of flesh and our “bodily sense of vulnerability to death” is shared by many non-human creatures, which our moral imagination and language fail to describe.³ Responding to the normative query “What ought we to do?” depends on what the world and we are, and on how the world and we came to be. The latter claim relates moral appraisal to co-evolution, the former to ecological dynamics. Ecology is imbedded in evolution⁴, and both are subsumed by the interminable duration of deep time. The implications of such temporal insights are clear. We, *Homo sapiens*, are a species of animal that is not *in* Nature, but *of* Nature, a species like all others with an ancestry that reaches back implausibly to the first spark of life on the Earth some 3.8 billion years ago. The prepositional distinction in the previous sentence is critical for conceptualizing our moral bearing intuitively within the context of deep time, as I elaborate in the next section of the paper. It leads us to inquire how moral philosophy can be naturalized by ascribing *Homo sapiens*’ ethical deportment to the fullness of the Earth’s deep evolutionary past. Being aware of the reality of our primordial roots, of our emergence from the ecological complexity of deep time is imperative for recognizing the wholeness of our biological nature, including an expansive morality “directed to all living things and perhaps too to the lifeless world that they inhabit.”⁵ No species can exist

alone, independent of a biological community, meaning that moral systems based on a human-Nature dualism are not simply lacking substance, they are false.⁶

My intent in this paper is to (a) synthesize some nuances about deep time expressed as the evolutionary and ecological emergence of the Earth's biodiversity; (b) explain how our ecological associations are vital for intuitive moral evaluation and crucial for the long-term survival of our species; and (c) propose how an ethic based on radical hope when conjoined to deep time may help us not only assuage despair, but also flourish with values better adapted to our ecological existence.

The Nature of Deep Time

The Earth was created about 4.6 billion years ago as a chaotic system of gases and energy, from which emerged sequentially a solid crust of stone, broad seas, primordial life, and billions of years later the diverse biological splendor of today, including the grace of *Homo sapiens*. None of these elaborate materializations could have been predicted, although they are explicable in retrospect. This sweeping view of the Earth's history—its deep time—is “geology's most frightening fact,” because all species including humans are “only an afterthought, a kind of cosmic accident.”⁷

Earth scientists and evolutionary biologists know this to be true, and yet most people dismiss the deep past as something that happened long ago, a narrative of epic proportion that is now done with and irrelevant to 21st-century humans and their moral ideals. This myopic perspective on the present moment is understandable from an evolutionary standpoint, because survival of *Homo sapiens* necessitated a focus on the day-to-day procurement of food, shelter, and mates. As such, we tend to live in the “now,” because “evolution has not (only) equipped humans for direct awareness of ecological changes,”⁸ but also blinded us to the fact that our continuing animal existence depends entirely on ecological processes that are embedded in the long-term geologic and biologic rhythms of the Earth. All species, including *Homo sapiens*, co-evolved and so are enmeshed in an interrelated, interdependent web of life. Disruption of any ecosystem's primary functions affects the whole that it is, as ecological dislocations ripple out from one domain of spatial and temporal order to another.⁹ Paradoxically, the sublime forces that unmake the world become those that recreate it. Put simply, creation always requires vanishing, whereby the stuff of everything emergent—whether mountains, ocean basins, species, organisms, cities, civilizations, technologies or whatever—is taken apart bit-by-bit and recombined into fresh patterns of materiality.

During this past century, the scientific enterprise has revealed a great deal about the functioning of ecosystems, providing fertile generalizations, particularizations, metaphors, theories, imagery, and language about the interdependency of ecological components and their nonlinear interactions. Consider the ecological transformations of the 21st-century world. The current rate of habitat destruction and its consequent mass extinction are not only accelerating, but are also more threatening to human existence than its contributor global warming. Some prominent biologists estimate that species are being extinguished at a rate somewhere between 3 and 300 species per day.¹⁰ If correct, the world's biodiversity in the next few centuries will be depleted by a staggering 25 to 50% of its species. The onset of this extinction crisis, the sixth in the Earth's history,¹¹ started about 50,000 years ago when Stone Age humans migrated out of

Africa into Europe, Asia, Australia, and the Americas, and systematically extirpated Pleistocene megafauna.¹² It carries on into the 21st century as the direct result of a burgeoning human population striving to achieve unending economic growth and material prosperity.¹³ Few, however, are willing to admit that the ongoing collapse of the biotic world is unstoppable, because the well-intentioned measures to conserve wildlife and to restore habitats can at best mitigate the gravity of this unremitting extinction event.¹⁴ Purging ethical concerns from this human-caused collapse of the global wild is illusionary, even morally dissolute as some insist.¹⁵ At the very least, we should recognize that the evolutionary roots of our species “...for better or worse, placed the responsibility for what happens in history squarely on the people who live through history.”¹⁶

Will the collapse of ecosystems worldwide affect human well-being? Despite our deep-seated emotions, principled rationality, and “thick” evaluative languages,¹⁷ *Homo sapiens* remains an animal species subject to the dynamic intricacies of ecosystems, whose habitability and biodiversity have been seriously compromised by the explosive success of our global industries and economies. In other words, we have conjured a self-limited concept of “the human,” and so are “tempted to equate transient domination (of the Earth) with either intrinsic superiority or prospects for extended survival.”¹⁸ The reality of deep time and the Earth’s deep future does not support this magnanimous self-perception of ourselves as beings who have transcended their animal birthright and are, therefore, immune to the wild whims of Nature. The sobering biological state of the 21st-century world as revealed by science circumscribes the true reality of the present. “In the past century we have accumulated a vast extinction debt that will be paid in the century ahead....Ecosystems will experience a dumbing down as built-in redundancies are eliminated. The web of life will become the strand of life.”¹⁹ Some, and I include myself, consider this massive kill-off to be a biocide of global proportion. By any measure, this is surely the most momentous moral crisis of humanity’s relatively brief 190,000-year-long existence as a species.

The cumulative metaphysical consequences that flow out of the aforementioned insights about the significance of deep time are numerous. I will mention four of them. They are: *i.* all living organisms extend their kinship back to the very first life form on the Earth; all living organisms are intimately related to one another; *ii.* *Homo sapiens*, like all species, co-evolved without intent or purpose; it simply happened; *iii.* the 21st century like all moments of deep time is ephemeral, because the Earth has a deep geologic future involving billions of years; and *iv.* all extant species, no matter how robust they seem, will eventually die out or transmute into different species; strata scattered everywhere about are littered with the fossilized body parts of their ancestors. The conclusion that follows logically from this deep-seated perspective is inescapable. All extant species, *Homo sapiens* included, share a common evolutionary heritage; all of them, *Homo sapiens* included, are fated to disappear forever. There is no other way to be alive, but to have the privilege to die as individuals and to fade out into obscurity as a species.

The denuded ecological patterns of the Earth’s landscapes at all scales oblige us to consider the complexifying events of the deep past, if we expect to understand and mitigate the ecological cascades that today are underway everywhere. Besides, biologists and conservation managers now know that ecosystems, because of their complex dynamic qualities, “are moving targets, with multiple futures that are uncertain and unpredictable.”²⁰ The worldwide breakdown

of ecosystems and its attendant mass extinction threaten not only the posterity of our descendants, but also ultimately our persistence as a species of animal entwined in an ever-unfolding web of life. According to Graeme Taylor, humankind is poised precariously at an ecological threshold “that can only result in either the catastrophic collapse of our unsustainable industrial system or its transformation into a sustainable planetary civilization. We are already well into the first part of this process—growing global crises. The question is no longer whether our unsustainable system will eventually collapse; the question now is whether humanity has the time and ability to avert disaster through creating a sustainable planetary civilization.”²¹ Claims to the contrary are delusionary and irrational. Knowing this and exercising reason and foresight, shouldn’t humans adapt to the reality of their ecological existence in ways that enhance rather than undermine their potential survivability as a species? The question is an urgent one and needs serious thought.

The Nature of morality

What is human nature? Every culture has grappled with this question, providing vital narratives that infuse the thoughts, memories, languages, rituals, artifacts, and lived experiences of people everywhere. My premise is that human nature is malleable and ever-evolving as a consequence of enmeshed biological and cultural forces.²² These two influences in concert and in conflict have enabled humans to adapt creatively to a relentlessly self-organizing world, understood as a mosaic of complex adaptive systems²³ in which “continuities intersect contingencies, contingencies encounter continuities, and through this process history is made.”²⁴

Materialist explanations of existence require that everything essential about the human condition be fixed firmly in the evolutionary development of *Homo sapiens*.²⁴ By any reasonable measure we are a species of animal, pure and simple, meaning that the deep ecosphere provides the fertile ground for our being. Put boldly, everything that we are or can ever be is ‘Earthly,’ fixed firmly and entirely by virtue of our emergence as a primate among interdependent assemblages of ecological communities and landscapes. From this naturalistic perspective, it follows logically that “biological principles lie at the root of ethics. The accumulation of facts and observations leads to the construction of values to enhance systemic efficiency and the ability of individuals, as well as the entire species, to survive. While values may vary from culture to culture, the principles of biology affecting human behavior that contribute to the evolution of value systems remains the same.”²⁶ Evolutionary emergence by natural selection has imbued humans with an instinctual drive to consider the aftermath of their deeds and judge them to be “right” or “wrong.” In other words, what has come into being from the evolutionary stirrings of the deep past is an animal with a moral imagination able to exalt ends above means, and then willfully choose to be virtuous, immoral, or indifferent. The potential for being either righteous or evil is thick in our animal being as the human history of the 20th century aptly demonstrates.

Two related questions fall out of this long, back-sighted view of *Homo sapiens*. To what extent is human well-being dependent on the biodiversity of the Earth? How can the adaptive qualities of moral systems promote the long-term existence of *Homo sapiens*? The former is addressed below, the latter in the final section of the paper. Before we press on though, a few concerns need to be addressed. Obviously, discourse in a brief paper is severely constrained.

Also, addressing the ecological complexities of the 21st century using the expansiveness of deep time is an unfamiliar habit of the mind, even among scientists. After all, most people argue that habitat destruction is happening *now*, and so people alive *today* must deal in a timely fashion with the environmental woes of the *present*. What's more, the accounts of ecological consequences are quite difficult for people to accept, due in large measure to the *principle of diminishing relevance*, whereby "the greater the time that separates a cause from a consequence, the less relevant we presume the cause to be."²⁷

My reply to such matters of dispute is straightforward. The ever-quickenings collapses of ecosystems everywhere in the 21st century emerged out of the deep history of our species. Furthermore, the ever-quickenings mass extinction that is underway has momentous, abiding consequences for the future state of the Earth and its biota, including human societies as part of those natural systems. In my view, an unduly constricted temporal focus makes it seem as though environmental problems are tractable, provided we apply adequate economic, political, scientific, and technological expertise. This confidence breeds complacency at a time when "(a)t the cutting edge of evolution, changing conditions and competition leave few options: species and societies either evolve or die off."²⁸ Can we afford to stand mute and guileless in sight of so much rampant ecological cascading? Is our unwillingness to face the historical weight of our current ecological dilemma a failure of a restrictive morality that privileges people over the ecosphere and denies the relevance of our instinctive animality for human well-being?

In this way of thinking, a better question than "who are we?" is "what are we?" Despite our 'exceptional' qualities, *Homo sapiens* descended from primate ancestors not in a solitary way, but as a constituent species of a complex biological community that emerged from a long-standing, well-documented history of speciation and extinction. Having co-evolved, humans share physical and nonmaterial traits with warm-blooded vertebrates. "That many kinds of mammals and birds...have a remarkably highly developed intelligence is no longer questioned by psychologists. But it is now realized that many animals also show that they have the emotions of fear, happiness, caution, depression, and almost every other human emotion....Obviously these human characteristics could not have all originated by a big saltation when *Homo sapiens* was born. Naturally, we find the antecedents in many species of animals."²⁹ This means that all things animate and inanimate, all the cross-scale ecological processes that shape the seconds of the 21st century unfolded out of a long biophysical journey that will continue to go nowhere in particular second-by-second for billions of years. Given this, are we not jeopardizing the survivability of our species by abusing ecosystems and intentionally overshooting the ecological carrying capacities of the landscapes we inhabit?³⁰ Is not the willful subversion of the Earth's creative potential by the massive kill-off of species a challenge to the claim that we are deeply moral creatures? For that matter, "(w)hat is the essence of our own morality if it fails to encompass most of the life on Earth?"³¹

The Millennium Ecosystem Assessment, a program launched by the UN Secretary-General Kofi Annan in 2001, appraised human well-being in the context of ecosystem services in their 2005 reports.³² The authors concluded that not only do ecosystems benefit humankind in critical ways, but also have "intrinsic value independent of any human concern."³³ Even from a utilitarian perspective, the Millennium Ecosystem Assessment Report states in its executive summary that "Ecosystems are essential for human well-being through their provisioning,

regulating, cultural, and supporting services. Evidence in recent decades of escalating human impacts on ecological systems worldwide raises concerns about the consequences of ecosystem changes for human well-being.”³⁴ Unfortunately, the dire warnings about the large-scale collapse of ecosystems are largely ignored by world governments. However, “(t)his is not the wide-eyed prophecy of radical Earth First! activists or the doom-and-gloom tale of corporate environmentalists trying to boost fundraising. It is the story that lurks behind a growing mountain of scientific papers published in prestigious scientific journals such as *Nature*, *Science*, and the *Proceedings of the National Academy of Sciences* over the past decade.”³⁵ Quite simply, “(e)very extinction...weakens the web of life that supports human societies.”³⁶ This unwillingness to live within ecological constraints most assuredly calls for *fierce conversations*³⁷ about reality. “While many are afraid of ‘real’, it is the unreal conversation that should scare us to death.”³⁸

What is the “real,” as proffered by science? We are a being entirely of Nature. We named ourselves *Homo sapiens* in recognition of that birthright. We do not live in the environment, surrounded by the beauty of its biology and landscapes. Rather, we share the evolutionary legacy of the Earth’s natural splendor; it is us. When we imperil ecosystems, we disabuse not just the Earth, but our humanity as well, including our purported moral ideals.³⁹ “As Gorbachev ...noted, ‘nature will not wait,’⁴⁰ and environmental experts warn that many environmentally damaging trends are now far too advanced to achieve real sustainability by means of gradual change: they believe human society has 30 to 40 years in which to act. Time is short, and humankind is already lagging behind.”⁴¹ What to do? At the very least, we need a fierce conversation about an ethos grounded in *radical hope*.⁴²

The Nature of radical hope

Most would agree that a courageous, moral person must face up to reality, must grasp the situation that she or he is in and, through lived experience and contemplative reflection, exercise good judgment. The intellectual formulation invoked by Hullot-Kentor for understanding the signification of “the primitive in ourselves and in reality”⁴³ is apropos for grasping the urgency of the ongoing extermination of species everywhere. “The question is not of possibly avoiding a tipping-point eight or fifteen years from now, but a question of what might be saved in absolute emergency.”⁴⁴ The dire ecological situation of the early 21st century cannot be construed merely as a set of environmental problems that have reductionist solutions. This is not about exceeding the *complicated* engineered resiliency of the artifice, but is about outstripping the *complex* ecological resiliency of the Earth.⁴⁵ The two can no longer be confounded, because we cannot, as many insist, cleverly use our technologies to wangle ourselves out of the cascading ecological crescendo of the present and its eventuated extinction crisis. This is not a mere degradation of the dike, but the buckling and imminent collapse of the entire embankment itself.

Given these actualities, where is the hope? What can be saved? “We cannot simply do nothing; neglect will not be benign...what must change is us...(w)hat remains is for us to wake up and see the moral linkages” between the extinction crisis and the anthropogenic impacts that are causing this effect.⁴⁶ All well and good, but where do such affirmations lead us in terms of workable solutions that will avert widespread ecological disasters. If we do commit to some

legitimate transposition, what should it be and how explicitly will it mitigate the ever-quickenening unraveling of the Earth's ecosystems and the massive die-off of their species?

In point of fact, from where can we derive hope given that we are a self-conscious creature of little account, living on an Earth that paradoxically is uncaring and insensible to the chaotic discord and the empty aftermath of mass extinctions? Ironically, it seems that the deep-time conceptualization of the human condition simultaneously frees and constrains our moral reasoning. Realistic evolutionary insights like these are incongruous. We act ethically and yet our lives have no long-standing value in the context of the Earth's deep time. Rather, it seems that the existence of *Homo sapiens*, like all species, is the means from which the Earth's deep future emerges, although the ecological ends are not foreseeable, final, or intended, regardless of how they eventuate. However true this cosmic aimlessness may be, there is no denying that moral perceptions matter a great deal to human beings, affording people purposeful lives of value, creativity, and joy. We would be inhuman or at the very least not fully human without an ethical mindset to spark the creative life within us. The drawn-out dynamics of evolutionary flux have infused our creaturely bodies with meaning and moral sentiment. Scientists and philosophers are learning that "purposes evolve, and Darwinian (evolutionary) processes extend them. Intelligence and creativity are purposes that have emerged over the course of life on Earth."⁴⁷

The randomness of evolutionary outcomes and ecological collapses are hard for most people to make sense of in any obvious way. What's called for, it seems to me, are stories that reconcile human existence with the life-affirming processes of the Earth, which birthed us as a species entwined within the splendid biological complexity of the ecosphere that is annealed by the inscrutably slow flux of deep time. Being authentic to that reality requires that we celebrate our biological roots that are anastomosed with everything that is alive—a vital co-dependence of some 30 million species alive together during the 21st century. This means that humans accept "...the arrival at identity by way of insignificance....We understand how much has preceded us, and how unimportant we are in relation to it. We learn our place, and we come to realize that it isn't a large one."⁴⁸ This naturalistic perspective of human existence bears directly on the moral comportment of *Homo sapiens*, a deep biological trait of our species.

The historian Jonathan Lear provides a means for coping with the drastic, unremitting changes that are forthcoming given the cascading collapse of the Earth's ecosystems. In his book, *Radical Hope: Ethics in the Face of Cultural Devastation*, Lear construes the exemplary moral imagination of Plenty Coups, the last great chief of the Crow Nation, at a time when his people were facing cultural ruination, due to the implementation of a U. S. government policy to lay claim to Indian land and relocate tribal people to reservations. Plenty Coups recognized that such treatment would assure the collapse of the Crow's traditional way of living, and negate their flourishing future as it had been conceived since the beginning of Crow time. What Plenty Coups apprehended is that the tragedy for the Crow would not be the loss of any one thing described by a certain point of view, but *the loss of the point of view itself*.⁴⁹

Lear paraphrases Plenty Coups: "I recognize in an important sense that we do not know what to hope for or what to aim for. Things are going to change in ways beyond which we can currently imagine. We certainly do know that we cannot face the future in the same way that we

have been doing... We must do what we can to open up our imaginations to a radically different set of future possibilities.”⁵⁰ The Crow Nation was at an impasse. Plenty Coups finally accepted the reality of this trying situation for his people, and realized that what needed to be protected at all costs was what is most essential to the Crow’s identity—the sacred mountainous core of their vast landscape; the rest of it would have to yield to forces that were impossibly powerful to deter. This adaptive approach was done “in the hope of clearing the ground for the creation of new forms of Crow subjectivity.”⁵¹

Despite the vilification from other chiefs, such as the Sioux Sitting Bull, who led his people to protracted war against the U.S. cavalry, Plenty Coups persisted with his vision and by deft negotiation retained control of the hallowed mountains of their beloved land, while ceding to the U. S. government large tracts of their heartland’s periphery. As a result of Plenty Coups’ vision, courage, and leadership, the Crow were a tribal people not humiliated and dehumanized by forced incarceration in a reservation compound. They had survived with dignity by being true to their essential being, and adapting with courage to the forces in the world that they could neither predict nor control.

In the midst of rampant and quickening habitat destruction and global extinctions, the future prospects for humankind, as they were for the Crow Nation, are unknowable and irrepressible, though they will be grave consequences for a way of life that is predicated on material wealth. As we cross ecological thresholds that will fundamentally reconfigure both the natural and human-built world, whatever can we do? What we dread involves the “...possibility of things’ ceasing to happen...How should we live with it?”⁵² As Plenty Coups came to realize, the tragic loss is not simply about one aspect of a way of life, but *the way of life itself*. And despite this abject bleakness, the Crow Nation persevered with self-esteem by adhering to a radical hope about a future goodness that is indeterminate because it “transcends our ability to understand what it is.”⁵³ By accepting his human vulnerability, Plenty Coups could only trust the goodness of the future and by creative adaptation extricate the Crow culture from certain annihilation.

This radical hope, not merely imagined but lived, seems especially relevant to people of the 21st-century. I am not advocating the adoption of a culture’s identity. That is impossible. What I’m claiming is that hope for all of us humans, for our species *Homo sapiens*, is based on an evolved moral potential, and these core values so essential to being fully human are the bridge between the Crow of the 19th century and all people of the 21st century. “When we wander over icy terrain, deserts, or uninhabited virgin steppes, our main concern is to avoid losing our way or our sense of present location. In this case maps are very handy, or in their absence one can navigate by the Sun or the stars...No such helpful tracking clues are available as we meander through the realm of sustainable development where the *fata morgana* of wishful thinking constantly threatens to lead us astray.”⁵⁴

What makes Plenty Coups’ hope radical was his willingness to commit the Crow Nation to a future goodness that eclipsed their ability to comprehend what it could be. As applied to the biodiversity crisis of the 21st century, the inception of radical hope is a moral position of the highest order, because it is a willingness to embrace with humility *Homo sapiens*’ finite nature and circumscribed intellect. What we believe is good about the natural world is exhausted by

our current understanding of it and of ourselves as continuing to emerge from it. Over the long term, we cannot confront the slow-moving forces of deep time over which we lack omnipotent control. What we can do, of course, is allow the events of the 21st century, whatever they may be, to intrude upon us, and respond with a nature-based imperative such that our moral demeanor, the very essence of our humanity, not only flourishes, but also strengthens and deepens in light of the ecological turmoil that will beset much of the natural and human-built world. Yes, mass extinction is underway and quickening, but the goodness of the community of life on the Earth is secure in the long term. After all, the wholesomeness of the 21st century—its awe-inspiring global ecologies—unfolded from 4.6 billion years of evolutionary effort that included five mass extinctions. Imagine the goodness that lies ahead in the deep geologic future for the Earth's yet-to-evolve biological communities. Radical hope is not so much about change as it is about returning to our core morality and embracing the authenticity of our natural existence as a member species of the Earth's ecosphere. All that we are and can possibly be is a species of animal that came out of the natural world, and we must now reenter the Earth's web of life with authentic moral convictions that befit the sophisticated nature of our co-evolutionary origin. This grand perspective of being and becoming is a reassuring one, is it not? An Earth-based perception of our animal existence rooted in deep time provides the deep moral context for deciding what we ought to do, given the emerging ecological reality of the 21st century.

References

1. Appiah, Kwame Anthony, *Experiments in Ethics*, Cambridge, MA: Harvard University Press, 2008.
2. Lakoff, George and Johnson, Mark, *Philosophy in the Flesh*, New York, NY: Basic Books, 1999.
3. Diamond, Cora, "Injustice and Animals," in *Slow Cures and Bad Philosophers: Essays on Wittgenstein, Medicine, and Bioethics*, ed. Elliott, Carl, Durham, NC: Duke University Press, 2001.
4. Kricher, John, *The Balance of Nature: Ecology's Enduring Myth*, Princeton, NJ: Princeton University Press, 2009.
5. Midgley, Mary, *Animals and Why They Matter*, Athens, GA: The University of Georgia Press, 1983.
6. Paterson, Barbara, "Ethics for Wildlife Conservation: Overcoming the Human-Nature Dualism," *BioScience* 56 (February 2006), 144-150; Rolston III, Holmes, "Global Environmental Ethics: A Valuable Earth," in *A New Century for Resource Management*, eds. Knight, Richard L. and Bates, Sarah F., Washington, DC: Island Press, 1995.
7. Gould, Stephen Jay, *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geologic Time*, Cambridge, MA: Harvard University Press, 1987.
8. Callenbach, Ernest, *Ecology*, Berkeley, CA: University of California Press, 2008.

9. Burkett, Virginia R. *et al.*, "Nonlinear Dynamics in Ecosystem Response to Climatic Change: Case Studies and Policy Implications," *Ecological Complexity* 2 (2005), 357-394; Phillips, Jonathan D., "Divergence, Sensitivity, and Nonequilibrium in Ecosystems," *Geographical Analysis* 36 (October 2004), 369-383; Manson, Steven M., "Simplifying Complexity: A Review of Complexity Theory," *Geoforum* 32 (2001), 405-414; Levin, Simon, "Ecosystems and the Biosphere as Complex Adaptive Systems," *Ecosystems* 1 (1998), 431-436.
10. Wilson, E. O., *The Creation*; Bender, Frederic L., *The Culture of Extinction: Toward a Philosophy of Deep Ecology*, Amherst, NY: Humanity Books, 2003.
11. Taylor, Graeme, *Evolution's Edge: The Coming Collapse and Transformation of Our World*, Gabriola Island, BC, Canada: New Society Publishers, 2008; Novacek, Michael, *Terra: Our 100-Million-Year-Old Ecosystem and the Threats That Now Put It at Risk*, Farrar, Straus, and Giroux, 2007; Koh, Lian Pin *et al.*, "Species Coextinctions and the Biodiversity Crisis," *Science* 305 (September 10, 2004), 632-634; Thomas, J. A. *et al.*, "Comparative Losses of British Butterflies, Buds, and Plants and the Global Extinction Crisis," *Science* 303 (March 19, 2004), 1879-1881; Eldredge, N. *Life in the Balance: Humanity and the Biodiversity Crisis*, Princeton, NJ: Princeton University Press, 1998; Leakey, Richard and Levin, Roger, *The Sixth Extinction: Patterns of Life and the Future of Humankind*, New York, NY: Doubleday & Co., 1996.
12. Mosimann, J. E. and Martin, P. S., "Simulating Overkill by Paleoindians," *American Scientist* 63 (1975), 304-313; Alroy, John, "A Multispecies Overkill Simulation of the End-Pleistocene Megafaunal Mass Extinction," *Science* 292 (June 8, 2001), 1893-1896.
13. McKibben, Bill, *The End of Nature*, New York, NY: Random House, 1989; Merchant, C., *The Death of Nature: Women, Ecology, and the Scientific Revolution*, San Francisco, CA: Harper and Row, 1980.
14. Meyer, Stephen M., *The End of the Wild*, Cambridge, MA: The MIT Press, 2006.
15. Bender, Frederic L., *The Culture of Extinction*.
16. Gaddis, John Lewis, *The Landscape of History*, New York, NY: Oxford University Press, 2002.
17. Appiah, Kwame Anthony, 2008.
18. Gould, Stephen Jay, *Full House: The Spread of Excellence from Plato to Darwin*, New York, NY: Three Rivers Press, 1996.
19. Meyer, Stephen M., 2006.
20. Gunderson, Lance H. and Holling, C. S., *Panarchy: Understanding Transformations in Human and Natural Systems*, Washington, DC: Island Press, 2002.
21. Taylor, Graeme, 2008.
22. Ehrlich, Paul R. *Human Natures: Genes, Cultures, and the Human Prospect*, Washington, DC: Island Press, 2000.

23. Levin, Simon A., "Self-organization and the Emergence of Complexity in Ecological Systems," *BioScience* 55 (December 2005), 1075-1079; Lansing, J. Stephen, "Complex Adaptive Systems," *Annual Review of Anthropology* 32 (2003), 183-204; Holling, C. S., "Understanding the Complexity of Economic, Ecological, and Social Systems," *Ecosystems* 4 (2001), 390-405; Levin, Simon, *Fragile Dominion: Complexity and the Commons*, Cambridge, MA: Perseus Publishing, 1999.
24. Gaddis, John Lewis, 2002.
25. Mayr, Ernst, *What Evolution Is*, New York, NY: Basic Books, 2001; Diamond, Jared D., *Guns, Germs, and Steel: The Fates of Human Societies*, New York, NY: Norton, 1997; Hull, D., "On Human Nature," in *Proceedings of the Philosophy of Science Association*, Fine, A. and Machamer, P. (eds.), East Lansing, MI: Philosophy of Science Association (1986), 3-13.
26. Bromberg, S. E., *The Evolution of Ethics: An Introduction to Cybernetic Ethics*, Berkeley, CA: Dianic Publications, 1999.
27. Gaddis, John Lewis, 2002.
28. Taylor, Graeme, 2008.
29. Mayr, Ernst, 2001.
30. Diamond, Jared, *Collapse: How Societies Choose to Fail or Succeed*, Viking, New York, NY, 2005; Mayr, Ernst, 2001.
31. Gaddis, John Lewis, 2002.
32. Millennium Ecosystem Assessment Report, *Ecosystems and Human Well-Being: Scenarios*, Washington, DC: Island Press, 2005a; Millennium Ecosystem Assessment Report, *Ecosystems and Human Well-Being: Current State and Trends*, Washington, DC: Island Press, 2005b; Millennium Ecosystem Assessment Report, *Ecosystems and Human Well-Being: Policy Responses*, Washington, DC: Island Press, 2005c.
33. *Ecosystems and Human Well-Being: A Framework for Assessment*, Washington, DC: Island Press, 2003.
34. Millennium Ecosystem Assessment Report, 2005a.
35. Meyer, Stephen M., 2006.
36. Taylor, Graeme, 2008.
37. Scott, Susan, *Fierce Conversations: Achieving Success at Work and in Life, One Conversation at a Time*, Berkeley, CA 2002.
38. *Ibid*
39. Shepard, Paul, *Nature and Madness*, San Francisco, CA: Sierra Club Books, 1982.

40. Gorbachev, M., “Editorial – The world: Nature will not wait,” *World-Watch* 14(2) (2001): 4-5.
41. Cairns, John, Jr., “Ethics in environmental politics and sustainable use of the planet,” *Ethics in Science and Environmental Politics* (June 26, 2001): 38-45.
42. Lear, Jonathan, *Radical Hope: Ethics in the Face of Cultural Devastation*, Cambridge, MA: Harvard University Press, 2006.
43. Hullot-Kentor, Robert, “The exact sense in which culture industry no longer exists,” *Cultural Critique* (Winter, 2009), forthcoming.
44. *Ibid*
45. Gunderson, L. H. and Holling, C. S., 2002.
46. Meyer, Stephen M., 2006.
47. Boyd, Brian, “Purpose-driven life,” *The American Scholar* (Spring 2009): 24-34..
48. Meyer, Stephen M. 2006.
49. Lear, Jonathan, *Radical Hope: Ethics in the Face of Cultural Devastation*, Cambridge, MA: Harvard University Press, 2006.
50. *Ibid*
51. *Ibid*
52. *Ibid*
53. *Ibid*
54. Danilov-Danil’yan, Victor I., Losev, K. S., and Reyf, Igor E., *Sustainable Development and the Limitation of Growth: Future Prospects for Civilizations*, Chichester, UK: Praxis Publishing, 2009.

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