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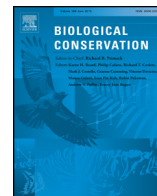
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## Three ways to think about the sixth mass extinction

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### ABSTRACT

A preponderance of evidence suggests humanity is causing a mass extinction event: the sixth mass extinction since the rise of complex life on Earth. This paper takes this empirical conclusion as given and asks a philosophical question: what is the meaning of the sixth mass extinction? How should we think about it, what should we do about it, and what does it tell us about humanity and our place in the world? Conservationists typically see mass extinction as an immense loss, as does most of the general public. But how best to characterize this loss is not immediately clear, and how we do so has important practical implications. This paper focuses on three common and plausible ways to think about the sixth mass extinction: as a loss of important resources (a mistake); as interspecies genocide (a crime); and as evidence that humanity is a cancer on the biosphere (as an inevitability). Considered together, these three approaches clarify the meaning of the sixth mass extinction and suggest how humanity ought to respond to it.

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### Introduction

By all accounts, biodiversity is rapidly diminishing across the globe. The [Secretariat of the Convention on Biological Diversity \(2010\)](#) estimates that humanity could extinguish one out of every three species on Earth within the next one to two hundred years, while according to [Raven et al. \(2011\)](#), “biodiversity is diminishing at a rate even faster than the last mass extinction at the end of the Cretaceous Period, 65 million years ago, with possibly two-thirds of existing terrestrial species likely to become extinct by the end of this century.” Conservation biologists debate whether current extinction rates are one thousand times normal background rates ([Pimm et al., 2014](#)) or “only” perhaps half that ([He and Hubble, 2011](#)); they disagree on how quickly current rates are likely to ramp up in the future ([Laurance, 2006](#); [Monastersky, 2014](#)). But even using conservative estimates for current extinction rates and holding these rates steady, projecting them forward a few hundred years predicts an immense loss of biodiversity ([Ceballos et al., 2015](#)). It thus seems probable that humanity is now causing a mass extinction event: the sixth mass extinction since the rise of complex life on Earth ([Magurran and Dornelas, 2010](#); [McLellan et al., 2014](#)).

Earth is a storied planet, and a good part of that story involves life evolving ever more variety and complexity ([Rolston, 2010](#)). For more than three and a half billion years living organisms have survived, thrived, and diversified: from zero to one to one million to perhaps ten million species today ([Tudge, 2000](#)). From a likely origin in shallow ocean waters, living species colonized the land and the skies, and spread across a vast range of habitats from the tops of mountains to deep ocean trenches, from bone-dry deserts to frigid Arctic tundra to scalding

thermal pools. Life has evolved the mind-bending complexity of the cell, with its many intricate mechanisms for nutrition, respiration, and self-regulation; and the further complexities of multi-cellular organisms, including animals with their simple and sophisticated behaviors, their many ways of subjectively experiencing the world, and their varied social systems. All these organisms, in turn, interact with one another in numerous different ways within the varied and evolving ecosystems of the world. Although we cannot say that nature “wants” greater biodiversity or that our world was fated to evolve as it did, the long-term trend has been a richer and richer biosphere ([Wilson, 2010](#)). And as far as we know, no single species has ever significantly reduced planetary-level biological diversity—until now.

While paleontologists debate the causes of previous mass extinctions, the primary cause of the current one is clear: us. The consensus among conservation biologists is that the five most important “direct drivers” of biodiversity loss today are habitat loss, the impacts of alien species, over-exploitation, pollution, and climate change, in many cases synergistically magnifying each others’ harms ([Sodhi and Ehrlich, 2010, chapters 4–8](#); [Primack, 2014, chapters 7–10](#)). All five direct drivers are themselves primarily driven by increased human populations ([Brashares et al., 2001](#); [McKee et al., 2003](#)) and increased human economic activity ([Wood et al., 2000](#)), which are often misleadingly described as “indirect drivers” (“primary drivers” or “ultimate drivers” would be more accurate terms). According to the *Millennium Ecosystem Assessment*, the force of these extinction drivers increased immensely over the past century as human populations and human economies exploded in size ([Reid et al., 2005](#)). Subsequent research ([Butchart et al., 2010](#); [Steffen et al., 2015](#)) bears out the *MEA*’s further conclusion that the forces driving extinction are increasing as individuals pursue wealth, corporations pursue profit, governments pursue economic and demographic growth,

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and ever more people consume, degrade, and appropriate ever more resources.

In what follows, I take the empirical facts above as given and ask a philosophical question: what is the meaning of the sixth mass extinction? How should we think about it, what should we do about it, and what does it tell us about humanity and our place in the world? To most people mass extinction seems like an immense loss, but how best to characterize that loss is not immediately clear (Kolbert, 2015). From among numerous possibilities, this paper focuses on three of the most common and plausible ways to think about anthropogenic mass extinction: as a mistake, as a crime, and as an inevitability. Exploring and comparing these three approaches clarifies the meaning and moral importance of the sixth mass extinction, and suggests how humanity ought to respond to it.

### 1st alternative: mass extinction as a waste of valuable resources (a mistake)

Perhaps the most common way contemporary conservation biologists talk about species extinction is as an immense waste of very valuable resources. From among numerous possible examples (e.g. Perrings et al., 2010), we can turn again to the *Secretariat of the Convention on Global Biodiversity's 3rd Global Biodiversity Outlook* (2010). "Biodiversity," its authors write, "underpins the functioning of ecosystems which provide a wide range of services to human societies. Its continued loss, therefore, has major implications for current and future human well-being. ... The provision of food, fibre, medicines and fresh water, pollination of crops, filtration of pollutants, and protection from natural disasters are among those ecosystem services potentially threatened by declines and changes in biodiversity."

In addition to biodiversity's role in securing health, physical security, and economic well-being, the authors appeal to further human interests, stating: "Cultural services such as spiritual and religious values, opportunities for knowledge and education, as well as recreational and aesthetic values, are also declining" with the worldwide reduction of biodiversity. The awkwardness of this wording ("spiritual values" provide people with "cultural services"?) suggests a problem articulating what is truly at stake in these non-economic aspects of biodiversity loss within a resource-oriented framework. Yet the authors hope that reminding readers of the full scope of human benefits derived from biodiversity strengthens their central message: "Changes in the abundance and distribution of species may have serious consequences for human societies" (*Secretariat of the Convention of Global Biodiversity*, 2010). Mass extinction of Earth's biodiversity is imprudent: a serious mistake that humanity will come to regret.

There is a solid core of truth in this way of talking about species loss. Maintaining crucial ecosystem services does sometimes depend on preserving native species and communities (Brandt et al., 2014). Arguably we are foreclosing important human possibilities through extinction and the loss of wild lands (Wilson, 2014). Beyond its truth, nature lovers hope that such resource talk will prove *useful*, giving them a means to convince those personally indifferent to species loss that they should support efforts to prevent it (Cimon-Morin et al., 2013). This potential usefulness appears to have motivated the authors of the influential *Millennium Ecosystem Assessment* to structure their analyses of biodiversity loss and ecological change within an ecosystem services framework (Wall, 2013); many conservation biologists have subsequently followed suit.

Still, this approach cannot capture the full meaning of the sixth mass extinction, for several reasons. First, it keeps the focus squarely on human beings' wants and needs, and locates the potential loss in a failure to meet them, now or in the future. But this seems perverse, since it is precisely humanity's efforts to satisfy our wants and needs that are driving global biodiversity loss (Jabado et al., 2015). Preventing mass extinction would necessarily involve reining in people's self-interested economic activities (Mushet et al., 2014; Pidgeon et al., 2014)—as well

as limiting the overproduction of human selves, each of whom inevitably places significant demands on the same limited resources needed by other organisms (Cincotta and Gorenflo, 2011; Mora and Sale, 2011). But resource talk does not lend itself to considering such limits; instead, it focuses attention on efficiently meeting ever-growing demands.

Second, the concept of "resource" strongly implies "substitutability" and hence the acceptability of extinguishing other species (Gorke, 2003; McCauley, 2006). Even quite valuable resources may be liquidated, on a standard economic view, if doing so will further human well-being. Many species, particularly rare ones, are likely of no economic value in any case, and their extinction is unlikely to affect ecosystem services (Vucetich et al., 2015). Yet many of us sense that the value of Emperor penguins or Bengal tigers cannot be fully explained by their usefulness to human beings (even on a broad understanding of 'useful'), nor can their extinction be balanced out morally by the potential benefits to people of degrading or appropriating their habitat.

Third, a focus on resource use tends to mean a focus on the short-term: attending to the next few decades in the case of particularly responsible corporate executives; looking a full century out among particularly far-seeing political leaders. But many species have existed for millions of years and could potentially exist and evolve for millions more; for example, crane (*Gruidae*) subfamilies were apparently distinct by the Late Eocene and present genera may be some 20 million years old. Many species of cranes are endangered, and ending such ancient careers through an inevitably present-centered resource consumption seems an important part of what is so wrong about the sixth mass extinction (van Dooren, 2014).

None of this means that species extinction does not involve an important loss of resources to humanity, or in some cases an unfair reallocation of resources away from human societies' poorer members. It does. Considering biodiversity as a human resource helps us capture some aspects of these losses and hence is necessary.

However, mass extinction is not just a mistake, and as a partial truth it is misleading when taken for the whole. A focus on prudent resource use cannot capture and in fact may systematically blind us to important moral aspects of the meaning of the sixth mass extinction (Deliège and Neuteleers, 2014). In particular, it obscures the independent histories and intrinsic value of other species (Agar, 2001; Cafaro and Primack, 2014). Attending to these seems likely to be particularly important if we hope to understand what it means to *end* these independent histories, or to subsume them, as tamed and ready-to-hand resources, within our own stories. Most worrying, an exclusive focus on their value as resources helps to justify the anthropogenic extinction of species that hold little or no value to humans, or that stand in the way of satisfying our interests.

### 2nd alternative: mass extinction as interspecies genocide (a crime)

Many of those who study anthropogenic species extinction see it as immoral: an injustice toward other species (Callicott and Grove-Fanning, 2009; Shoreman-Ouimet and Kopnina, 2015). One forceful way to capture such a moral claim involves describing the extinction of other species as interspecies genocide. In his recent book *Planet Without Apes* (2012), for example, Craig Stanford claims that: "humans have carried out a campaign of extermination against the great apes that has reached epic proportions." "If it were a slaughter of human beings," he writes: "it would be called by its rightful name: genocide. ... Like the European colonists of the tropics who encountered widespread indigenous civilizations but declared the land to be 'empty', those who carry out the ape genocide today do it blithely, without considering their actions a violation of any natural law. Like all colonists, we kill in the name of progress and denigrate the victims to rationalize the genocide. After all, they are animals, we are humans."

The great apes may be particularly plausible candidates for such a moral claim, due to their advanced cognitive abilities, varied cultures, and close kinship with humans (Cavaliere and Singer, 1994). But

conservationists have accused people of callousness or injustice in a much wider range of cases involving the displacement of other species (Carson, 1962; Leopold, 1970; Thoreau, 1989). The general claim is that through habitat conversion, over-exploitation, and the other effects of humanity's ceaseless expansion, we are deliberately replacing *them* with *us* and our economic support systems, in ways that add up to a violation of other species' right to continued existence (Staples and Cafaro, 2012).

The word 'genocide' comes from the Greek root *genos*, meaning kin, group, or people, and the Latin *cide*, for killing. In standard use the term denotes "the denial of the right of existence of entire human groups, as homicide is the denial of the right to live of individual human beings" (Osmańczyk and Mango, 2003). If we accept that natural kinds can be exterminated as a result of conscious human actions and (more controversially) that such actions can count as violations of morality and justice, the term may apply to many recent extinctions, and perhaps to the sixth mass extinction as a whole.

Some may object that genocide is an inappropriate term for mass species extinction, either because people are not killing off other species on purpose, or because the term only properly applies to violence against humans (Szybel, 2006). Regarding the first objection, it is true that direct intent has typically been seen as a necessary condition for a finding of genocide under international law. The United Nations Convention on the Prevention and Punishment of the Crime of Genocide defines genocide as involving "acts committed *with intent* to destroy, in whole or in part, a national, ethnical, racial or religious group, as such"; and as "*deliberately* inflicting on the group conditions of life *calculated* to bring about its physical destruction in whole or in part" (Scott, 2006, emphases added). The Nazi Holocaust is a paradigm of genocide in this sense, with its explicit plan to destroy all Europe's Jews and its development of a highly organized infrastructure to do so.

Yet subsequent episodes of genocide have called this "intentionalist" paradigm into question (May, 2010). The Rwandan genocide in the 1990s, for example, apparently was not the result of thorough governmental coordination, or an overriding desire to exterminate every last Tutsi or Hutu (Diamond, 2005). Examples of genocide against indigenous peoples standing in the way of agricultural settlement or industrial development often do not fit the intentional model either, being loosely organized or not involving a commitment to full elimination of the undesirable group. Rather than being driven primarily by racial ideology, economic interests and demographic pressures often seem the key drivers of intergroup violence (overpopulation seems to have been particularly important in Rwanda (Gasana, 2002)). According to Shaw (2007): "It is actually very difficult to conceive of genocide without a territorial dimension ... Destroying a social group always means destroying its presence and its economic, social and cultural power within a given territory" and taking that territory for one's own group.

So, while it is true that there is no evil cabal planning a "final solution" to wipe out the world's birds or beetles, and often no conscious malice toward the species people displace, we do see a relentless and intentional human appropriation of territory and resources across the globe. Once we recognize economic and demographic growth as the fundamental underlying causes of species extinctions, and remember that growth is the primary organizing goal of corporations and governments around the world, any claim that people are *inadvertently* extinguishing species rings hollow. Presumably it does not absolve us of moral responsibility to say we would have preferred to have greater wealth, bigger profits, or more economic growth without harming other species (if it did, a car thief would be free to claim in court that it was not his intent to leave you trudging by the side of the road; he just wanted your car).

The key moral fact appears to be humanity's refusal to control itself, or to take the steps necessary to adequately protect other species. Over the past hundred years the world's population has increased over 300% and the size of the global economy has increased at least 1500%, on a conservative estimate (Steffen et al., 2015). This explosion of the

human presence has shrunk and fragmented wild places, decimated many animal and plant populations, spread bio-homogeneity, and extinguished countless species. Yet we refuse to limit our numbers on a planetary scale, and we refuse to limit our per capita demands on natural resources by ending, or even slowing, economic growth (Hardin, 1993). As a result, ocean life is reduced to food and bycatch; rainforests are razed for meat production, soybeans, palm oil and timber; boreal and temperate forests are cut down and exploited for their wood, pulp and energy resources; mountains are blown apart for their coal; deep sea floors are punctured for oil; grasslands are overgrazed or converted into strictly-human breadbaskets; freshwaters are channelized, dammed, polluted, and overfished; and animals are exterminated at an unprecedented pace, either displaced, or killed for their meat and lucrative body parts (Butler, 2015). Arguably these activities add up to an intentional refusal to leave sufficient resources for other species' continued existence and hence to interspecies genocide: a great crime against nature, as conventional genocide is typically understood to be a great crime against humanity.

As for the second possible objection, that only human groups can be victims of genocide—tell that to the dodo. The giant moa. The passenger pigeon. The thylacine. The baiji dolphin. The golden toad. The American bison (bison are a particularly interesting case, since they were cleared off America's Great Plains in the second half of the nineteenth century in part through organized U.S. government campaigns to displace Native American tribes (Smits, 1994)). Surely there is no logical or scientific reason we cannot use the term 'genocide' to refer to extinguishing non-human as well as human groups. The fundamental question is the moral question: are other species worth our consideration, our respect, our restraint? Do they, as Aldo Leopold claimed in *A Sand County Almanac* (1970), have a right "to continued existence, and, at least in spots, their continued existence in a natural state?"

Arguably they do. Species are the primary examples and repositories of organic nature's order, creativity, and diversity. They represent millions of years of development and, as a result, possess immense amounts of DNA-coded adaptive knowledge. The organisms comprising a species often show incredible functional, organizational, or behavioral complexity. Every species, like every person, is unique, with its own history and destiny. Every species is an ongoing achievement. These empirical truths support the moral claim that species possess great intrinsic value and that people should appreciate and defend that value—not destroy it (Rolston, 1989; Vucetich et al., 2015).

Such moral claims are contested (Palmer, 2009; Sandler, 2012). They cannot be proven true, any more than we can prove that it is wrong for more powerful human groups to steal land from weaker ones. To deny these moral claims, however, necessarily involves accepting the alternative view of other species as *nothing more than* resources for human use. Conservationists and the societies we work within appear to face a moral choice here—a choice that, no matter how well informed by science, moves beyond science. We can try to find the words to articulate a moral relationship between humanity and other species, consider what would constitute a fair distribution of resources between us (Noss et al., 2012; Wilson, 2014 urge humanity to "leave half for nature"), and try to live up to that ideal. Alternatively, we can retreat into a purely instrumental conceptualization of our relationship to the rest of the living world—an approach that most conservation biologists intuitively sense is inadequate to fully explain what is at stake in the sixth mass extinction—and live accordingly.

### **3rd alternative: mass extinction as evidence that humanity is a cancer on the biosphere (an inevitability)**

Preventing interspecies genocide depends on recognizing other species' right to continued existence and sharing territory (habitat and resources) with them. True, as physical beings, people must transform some wild nature into instrumental resources for our own survival



and reproduction. But as conscious, moral beings, we can limit this appropriation. We can avoid interspecies genocide.

Unless, of course, we can't. Consider that when conservationists do call for limits to population growth or economic expansion, mainstream economists and politicians typically tell us that limiting growth is unnecessary, immoral, or impossible (Friedman, 2006). "There are no... limits to the carrying capacity of the Earth that are likely to bind any time in the foreseeable future," former Treasury Secretary Lawrence Summers assured Americans a few years ago (predictably defining "carrying capacity" solely in terms of human beings). "There isn't a risk of an apocalypse due to global warming, or anything else. The idea that we should put limits on growth because of some natural limit is a profound error" (cited in McKibben, 2007). Most contemporary environmental leaders are afraid to challenge this view; instead, they typically advocate "smart growth" that is less environmentally damaging than business as usual, while ignoring population growth altogether (Speth, 2009). What this necessarily means—whether growth is smart or dumb, pretty or ugly, fairly or unfairly distributed among people—is the continued displacement of wild nature. More of us and less of most other species, with the exception of a few of humanity's domesticates and commensals.

Doctors have a word for the rapid and uncontrolled growth of one part of an organism at the expense of the whole: cancer, which may be defined as an abnormal growth of body tissue that is incoordinate with surrounding normal tissues and hence is harmful to the organism (McKinnell et al., 2006). Here we have a final template for understanding the sixth mass extinction: humanity as a cancer on the biosphere. "The planet is about to break out with fever, indeed it may already have, and we [human beings] are the disease," remarked Thomas Lovejoy, at a conference devoted to human threats to the global environment (cited in Brooks, 1989). "Cultures have become consumptive, with an ever-escalating growth of insatiable desires, overlaid on an ever-escalating population growth," claimed environmental ethicist Rolston Holmes (1994) a few years later. "Starkly put, the growth of culture has become cancerous. That is hardly a metaphor, for a cancer is essentially an explosion of unregulated growth." More recently, Harte Mary and Ehrlich Anne (2011) warned: "perpetual growth is the creed of a cancer cell, not a sustainable human society."

According to the medical literature, cancerous growths display four main characteristics: (1) rapid, uncontrolled growth; (2) de-differentiation in cancer cells themselves; (3) the invasion and destruction of adjacent normal tissues; and (4) metastasis to different sites within the body (McKinnell et al., 2006). Hern (1990, 1999) has detailed the close parallels between current human growth patterns and these four characteristics of cancer. The homogenization of human cultures around the world, shown most clearly in the rapid loss of human languages and the displacement of traditional subsistence activities by industrial economic processes, suggests an ongoing process of de-differentiation among *Homo sapiens* (characteristic 2). Human expansion into natural areas adjacent to our existing settlements parallels characteristic 3, while our colonizing sites far distant from them, which then often become the nuclei for new and expanding settlements, parallels characteristic 4. But the key correspondence to consider involves characteristic 1: the rapid and uncontrolled growth of a part—in this case, a single species—that is harmful to the biosphere as a whole. Is this a fair summary of humankind's current role in the biosphere?

Over the past few centuries, humanity's growth in numbers and ecological impact has indeed been extraordinarily rapid. This is so whether we compare it to past human growth rates, or to the global impacts of any other single species that scientists have observed in nature (Meadows et al., 2004). It seems equally clear that this growth has often come at the expense of the health and integrity of Earth's ecosystems. Witness within recent decades steeply declining numbers for many of the world's vertebrate species (McLellan et al., 2014), the growth of immense "dead zones" at the mouths of many major rivers (Wohl, 2011), vast monocultures of a few crops replacing biodiverse

forests and grasslands (Davidai et al., 2015), the bleaching of a sizable fraction of the world's coral reefs (Briggs, 2005), and numerous other examples. Finally, this constant scaling up of the human presence on Earth does indeed seem out of control: both in the sense that human technological ingenuity has allowed us to push beyond ecological constraints that limited our numbers and impacts in the past; and in the sense that our leaders and institutions do not clearly have the ability to limit this growth, even if they desired to do so (Dilworth, 2009). In these ways the key parallel between organismal cancer and 21st century humanity—both manifesting rapid, uncontrolled, and harmful growth—appears to hold.

In considering the previous alternative—extinction as an injustice, as interspecies genocide—we spoke as if human beings were free to choose whether to plunge ahead in enacting the sixth mass extinction. Such moral judgments imply freedom to select among alternative courses of action (as the philosophers say, "ought implies can"). Conservation biologists hope current human societies have this freedom—the ultimate success of our practical conservation work depends upon it—but perhaps they do not. Perhaps the economists and politicians are right and we really cannot stop growing (until we crash). In that case the meaning of the sixth extinction would change considerably. Humanity would then look less like a gang of greedy criminals and more like cancer: a natural process that for whatever reason has slipped its normal bounds and is now out of control. Not evil, perhaps, or the product of conscious ill intent, but still a very unfortunate occurrence.

Of course, the notion of "humanity as cancer" grates. Who wants to think of themselves, or their children, as part of a sickening, life-threatening disease? Many of us know people who have suffered from cancer. The whole way of speaking seems in bad taste. Yet we must admit that people give every indication of being out of control in terms of our use and appropriation of the living world. To call humanity a cancer on the biosphere is to say, first, that other organisms, species, and places can indeed be healthy and full of life (Pimentel et al., 2013); second, that humanity can harm this life: pave it over, strangle it on poisons, or otherwise degrade or destroy it; third, that human growth is the main cause of this harm; and fourth, that this growth is out of control and cannot be consciously stopped. Points one through three seem obviously true, while point four appears at least *prima facie* plausible.

### Can we limit (or even talk about limiting) growth?

To this line of thought, a critic might respond that people *can* limit our growth if we choose to do so, and she could point to particular instances where this has occurred. There are numerous examples of communities setting aside lands or waters in order to preserve other species (Terborgh et al., 2002); of nations whose citizens freely choose to limit their own reproduction and thus stabilize their populations (United Nations Population Fund, 2012); even of policy-makers trading some amount of economic growth in order to achieve important social goals, such as a more equitable distribution of wealth (Stiglitz et al., 2009). Such cases provide hope for biodiversity advocates and others working for justice and sustainability around the world. So does the growing popularity of new approaches to economics that recognize ecological limits and work to specify what truly sustainable economies would look like, such as the rising discipline of ecological economics and the international de-growth movement (Dietz and O'Neill, 2013; Daly, 2015).

Yet in the global context, these efforts seem weak countercurrents of potential interspecies generosity within a larger storm surge of growth that threatens to wash all such efforts away; as protected areas lose native biodiversity due to climate change, for example (Shen et al., 2015), or are de-gazetted in order to accommodate further economic development (Mascia et al., 2014). With rare exceptions, the human surge itself is not called into question by mainstream political leaders or by the general public. It is hard to see how humanity can preserve global biodiversity over the long term when comprehensively limiting growth is not

under consideration—even among those who would seem the most likely advocates for such limits.

To take one important example, the *Intergovernmental Panel on Climate Change's fourth and fifth Assessment Reports* (2007, 2014) clearly identified population growth and increased per capita wealth as the main drivers of increased global greenhouse gas emissions. Yet neither report considered stabilizing human populations or slowing economic growth as means to limit growing emissions (Cafaro, 2011). Both focused solely on efficiency improvements, despite the proven failure of such improvements to keep pace with growth-driven increases in emissions, and despite warnings that humanity was moving perilously close to potentially catastrophic climate change. This was the global scientific community advising the world's governments about a threat that could lead to the loss of many millions of human lives. If people cannot consider limits to growth in order to meet such a dire threat to ourselves, there is little reason to think we will do so to protect other species.

In this regard, consider once again the *3rd Global Biodiversity Outlook* (2010), which stated: “Effective action to address biodiversity loss depends on addressing the underlying causes or indirect drivers of that decline.” As we have seen, those ultimate drivers are demographic and economic growth. But what would timely and effective action to address them mean in practice? Among the report's suggestions (emphases added):

“Much *greater efficiency* in the use of land, energy, fresh water and materials *to meet growing demand*.” [not limiting demand itself]

“*Use of market incentives, and avoidance of perverse subsidies* to minimize unsustainable resource use and wasteful consumption.” [not mandatory upper limits to human resource use or consumption]

“*Strategic planning* in the use of land, inland waters and marine resources *to reconcile development with conservation of biodiversity*.” [not setting limits to the total amount of developed land or waters]

In other words, biodiversity conservation can include whatever policy changes or managerial efficiency improvements are compatible with the pursuit of continued growth—and nothing more. The authors of the *3rd Global Biodiversity Outlook*, many of them biologists, lament the continued rapid loss of the world's biodiversity and acknowledge that previous conservation efforts have proven insufficient to stem this loss. Yet they do not discuss, much less advocate, measures that challenge the pro-growth economic status quo. Coming from a group charged with charting a plausible way forward for preserving the world's biodiversity, this is a stunning failure, and a clear example of the grip that economic orthodoxy has on contemporary conservationists' imaginations. We are left with growth as a powerful and largely unchallenged force shaping the future of the biosphere. Indeed, far from questioning the economic status quo, advocates for the popular “new conservation” argue for even greater accommodation between conservation biologists and the government and business leaders whose activities are accelerating the sixth mass extinction (Miller et al., 2013). As the former chief scientist of the Nature Conservancy puts it, conservationists should quit “scolding capitalism,” or questioning the need for rapid economic development to accommodate increasing human populations (Kareiva et al., 2011).

The ability to restrain ourselves lies at the core of humanity's ostensible superiority over the rest of nature. The great philosopher Immanuel Kant (1964) clearly laid out this view over two hundred years ago: rationality → choice → freedom → morality. Our ability to reason allows human beings to distinguish between different courses of action and choose one over another. This constitutes a limited, yet real, freedom, which in turn demands that we act with justice and generosity in a world that we have so much power to influence, for good or ill. We do not expect wombats, redwoods, or cancer-causing viruses to respect rights or appreciate limits. We do expect this from people. The claim is

that humanity is different precisely because we can act with foresight, planning, restraint, and higher ends in view. But can we? Can people act intelligently and with restraint as a global community that collectively holds the fate of Earth's ten million species in its hands? That is far from clear.

If restraint in our use of the resources needed by other species is ultimately beyond us, that would seem to let humanity off the hook, morally speaking, for causing the sixth mass extinction. Yet the resulting self-portrait—of a deadly and destructive force, mindless and out-of-control, ripping great holes in the tapestry of life and creating an ugly and diminished world—is hardly one that most people will willingly embrace. We want and need to believe that people are capable of freely choosing a better future for ourselves and our children: one that preserves nature's beauty and diversity, and our own self-respect (Bendik-Keymer, 2010). But if we reject the model of human beings as a cancer on the biosphere, as I think we should, then we must curb the economic and demographic trends that have turned humankind into such a deadly threat to the rest of life (Cafaro, 2010). We must redouble our efforts to find the words to articulate ethical relationships toward the living world, and work to create policies, institutions, and lives that make such loving and respectful relationships a reality.

## Conclusion

What is the meaning of the sixth mass extinction of life on Earth? We have considered three possible ways of thinking about this loss, each of which captures important elements of the overall situation. My main conclusions are as follows. First, extinction does represent an important loss of resources for people, but this framework fails to capture what is morally most important regarding anthropogenic species extinction: the injustice of human beings unnecessarily extinguishing myriad other forms of life. Second, if we can end the current mass extinction, but fail to do so, then humanity will indeed be guilty of inter-species genocide. Third, if human beings cannot end the current mass extinction, because limiting our own growth is beyond our capabilities, then we will have proven ourselves a cancer on the biosphere. In the second case, as with any genocide, responsibility for causing the harms in question will vary among particular individuals and groups, while in the third case, issues of individual or group responsibility will be moot (since by hypothesis such harms are seen as unavoidable). Either way, future generations are unlikely to be proud of the results.

These three possibilities do not exhaust the potential meanings of the sixth mass extinction. In particular, I have not considered the possibility that extinguishing a large fraction of Earth's species is not problematic at all, but simply collateral damage to a more important story centered on humanity's technological, economic, and social development, on Earth (Kurtzweil, 2006) or beyond (Impey, 2015). Stated explicitly, such a view seems unacceptably solipsistic (although an informal review of recent “futurist” writings suggests it may be more widespread than conservationists would like to think). Similarly, I have not considered the possibility that humanity might wake up to our moral responsibilities and take the steps necessary to end the sixth mass extinction. Given our failure to seriously consider limits to growth, such a possibility currently appears remote.

Still, conservation biologists know what measures are necessary to end the sixth mass extinction, even if we rarely advocate for such measures. Humanity would need to end our global population explosion (Cincotta and Engelman, 2000; Foreman and Carroll, 2015), set aside sufficient lands and waters for other species to flourish over the long term (Wilson, 2014; Wuerthner et al., 2015), and create economies based on sustaining a limited number of people in comfort, rather than endlessly more people in luxury (Rands et al., 2010; Noss et al., 2013). Armed with this knowledge, it is theoretically possible that human beings could find the moral clarity and the will to create societies that shared Earth's lands and seas generously with other species. Aldo Leopold (1970) imagined this as people living as “plain members

and citizens” rather than “conquerors” of the biosphere. E.O. Wilson (2006) speaks of cultivating our natural biophilia and embracing the roles of stewards and storytellers for the rest of life. Holmes Rolston (2012) asks us to forego dreams of domination or possession and instead inhabit our home planet with love. Averted rather than enacted, the sixth mass extinction would say something very different, and much better, about humanity and our career on Earth.

## References

- Agar, N., 2001. *Life's Intrinsic Value*. Columbia University Press, New York.
- Bendik-Keymer, J., 2010. Species extinction and the vice of thoughtlessness: the importance of spiritual exercises for learning virtue. In: Cafaro, P., Sandler, R. (Eds.), *Virtue Ethics and the Environment*. Springer, Dordrecht, pp. 61–83.
- Brandt, P., Abson, D., DellaSala, D., Feller, R., von Wehrden, H., 2014. Multifunctionality and biodiversity: ecosystem services in temperate rainforests of the Pacific Northwest, USA. *Biol. Conserv.* 169, 362–371.
- Brashares, J., Arcese, P., Sam, M., 2001. Human demography and reserve size predict wildlife extinction in West Africa. *Proc. R. Soc. B* 268, 2473–2478.
- Briggs, J., 2005. Coral reefs: conserving the evolutionary sources. *Biol. Conserv.* 126, 297–305.
- Brooks, D., 1989. Journalists and others for saving the planet. *Wall Str. J.* A28 (5 October).
- Butchart, S., Walpole, M., Collen, B., et al., 2010. Global biodiversity: indicators of recent declines. *Science* 328, 1164–1168.
- Butler, T., 2015. *Overdevelopment, Overpopulation, Overshoot*. Goff Books, Novato, California.
- Cafaro, P., 2010. Economic growth or the flourishing of life: the ethical choice global climate change puts to humanity in the 21st century. *Essays in Philosophy* 11/1.
- Cafaro, P., 2011. Beyond business as usual: alternative wedges to avoid catastrophic climate change and create sustainable societies. In: Arnold, D. (Ed.), *The Ethics of Global Climate Change*. Cambridge University Press, Cambridge, pp. 192–215.
- Cafaro, P., Primack, R., 2014. Species extinction is a great moral wrong. *Biol. Conserv.* 170, 1–2.
- Callicott, B., Grove-Fanning, W., 2009. Should endangered species have standing? Toward legal rights for listed species. *Soc. Philos. Policy* 26, 317–352.
- Carson, R., 1962. *Silent Spring*. Fawcett Books, New York.
- Cavaliere, P., Singer, P. (Eds.), 1994. *The Great Ape Project: Equality Beyond Humanity*. St. Martin's Press, New York.
- Ceballos, G., Ehrlich, P., Barnosky, A., Garcia, A., Pringle, R., Palmer, T., 2015. Accelerated modern human-induced species losses: entering the sixth mass extinction. *Sci. Adv.* 1 (5), e1400253. <http://dx.doi.org/10.1126/sciadv.1400253>.
- Cimon-Morin, J., Darveau, M., Poulin, M., 2013. Fostering synergies between ecosystem services and biodiversity in conservation planning: a review. *Biol. Conserv.* 166, 144–154.
- Cincotta, R., Engelman, R., 2000. *Nature's Place: Human Population and the Future of Biological Diversity*. Population Action International, Washington, DC.
- Cincotta, R., Gorenflo, L. (Eds.), 2011. *Human Population: Its Influences on Biological Diversity*. Springer, Heidelberg.
- Daly, H., 2015. *From Uneconomic Growth to a Steady-State Economy*. Edward Elgar.
- Davidai, N., Westbrook, J., Lessard, J.-P., Hallam, T., McCracken, G., 2015. The importance of natural habitats to Brazilian free-tailed bats in intensive agricultural landscapes in the Winter Garden region of Texas, United States. *Biol. Conserv.* 190, 107–114.
- Delière, G., Neuteleers, S., 2014. Ecosystem services as an argument for biodiversity preservation: why its strength is its problem — reply to Cimon-Morin, et al. *Biol. Conserv.* 172, 218.
- Diamond, J., 2005. *Collapse: How Societies Choose to Fail or Succeed*. Penguin, New York.
- Dietz, R., O'Neill, D., 2013. *Enough is Enough: Building a Sustainable Economy in a World of Finite Resources*. Berrett-Koehler.
- Dilworth, C., 2009. *Too Smart for Our Own Good: The Ecological Predicament of Humankind*. Cambridge University Press, Cambridge.
- van Dooren, T., 2014. *Flight Ways: Life and Loss at the Edge of Extinction*. Columbia University Press, New York.
- Foreman, D., Carroll, L., 2015. *Man Swarm: How Overpopulation is Killing the Wild World*. LiveTrue Books, Charleston, South Carolina.
- Friedman, B., 2006. *The Moral Consequences of Economic Growth*. Vintage, New York.
- Gasana, J., 2002. Remember Rwanda? *World Watch* 24–33 (September/October).
- Gorke, M., 2003. *The Death of Our Planet's Species: A Challenge to Ecology and Ethics*. Island Press, Washington, DC.
- Hardin, G., 1993. *Living Within Limits: Ecology, Economics, and Population Taboos*. Cambridge University Press, Cambridge.
- Harte, M., Ehrlich, A., 2011. The world's biggest problem? Too many people. *Los Angeles Times*, July 21.
- He, F., Hubble, S., 2011. Species–area relationships always overestimate extinction rates from habitat loss. *Nature* 473, 368–371.
- Hern, W., 1990. Why are there so many of us? Description and diagnosis of a planetary ecopathological process. *Popul. Environ.* 12, 1–27.
- Hern, W., 1999. How many times has the human population doubled? Comparisons with cancer. *Popul. Environ.* 21, 59–80.
- Impey, C., 2015. *Beyond: Our Future in Space*. W.W. Norton, New York.
- Intergovernmental Panel on Climate Change, 2007. *Summary for Policymakers. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- Intergovernmental Panel on Climate Change, 2014. *Summary for Policymakers. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- Jabado, R., Al Ghaiss, S., Hamza, W., Henderson, A., Spaet, J., Shivji, M., Hanner, R., 2015. The trade in sharks and their products in the United Arab Emirates. *Biol. Conserv.* 181, 190–198.
- Kant, I., 1964. *Groundwork of the Metaphysics of Morals*. Harper & Row, New York.
- Kareiva, P., Lalasz, R., Marvier, M., 2011. Conservation in the Anthropocene: beyond solitude and fragility. *Breakthrough J.* 29–37 (Fall).
- Kolbert, E., 2015. *The Sixth Extinction: An Unnatural History*. Picador, New York.
- Kurtzweil, R., 2006. *The Singularity is Near: When Humans Transcend Biology*. Penguin, New York.
- Laurance, W., 2006. Have we overstated the tropical biodiversity crisis? *Trends Ecol. Evol.* 22, 65–70.
- Leopold, A., 1970. *A Sand County Almanac with Essays on Conservation From Round River*. Ballantine Books, New York.
- Magurran, A., Dornelas, M., 2010. Introduction: biological diversity in a changing world. *Philos. Trans. R. Soc. B* 365, 3593–3597.
- Mascia, M., Pailler, S., Krithivasan, R., Roshchanka, V., Burns, D., Mlotha, M., Murray, D., Peng, N., 2014. Protected area downgrading, downsizing, and degazettement (PADDD) in Africa, Asia, and Latin America and the Caribbean, 1900–2010. *Biol. Conserv.* 169, 355–361.
- May, L., 2010. *Genocide: A Normative Account*. Cambridge University Press, Cambridge.
- McCauley, D., 2006. Selling out nature. *Nature* 443, 27–28.
- McKee, J., Scullia, P., Foocea, C., Waitea, T., 2003. Forecasting global biodiversity threats associated with human population growth. *Biol. Conserv.* 115, 161–164.
- McKibben, B., 2007. *Deep Economy: The Wealth of Communities and the Durable Future*. St. Martin's Press, New York.
- McKinnell, R., Parchment, R., Perantoni, A., Damjanov, I., Pierce, G., 2006. *The Biological Basis of Cancer*. 2nd ed. Cambridge University Press, Cambridge.
- McLellan, R., Iyengar, L., Jeffries, B., Oerlemans, N. (Eds.), 2014. *Living Planet Report 2014: Species and Spaces, People and Places*. World Wildlife Fund, Washington, DC.
- Meadows, D., Randers, J., Meadows, D., 2004. *Limits to Growth: The 30-Year Update*. Chelsea Green Publishing, White River Junction, VT.
- Miller, B., Soule, M., Terborgh, J., 2013. The 'New Conservation's' Surrender to Development. *The Rewilding Institute*, Albuquerque, NM.
- Monastersky, R., 2014. Life: a status report. *Nature* 156, 158–161.
- Mora, C., Sale, P., 2011. Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. *Mar. Ecol. Prog. Ser.* 434, 251–266.
- Mushet, D., Neau, J., Euliss Jr., N., 2014. Modeling effects of conservation grassland losses on amphibian habitat. *Biol. Conserv.* 174, 93–100.
- Noss, R., Dobson, A., Baldwin, R., et al., 2012. Bolder thinking for conservation. *Conserv. Biol.* 26, 1–4.
- Noss, R., Nash, R., Paquet, P., Soule, M., 2013. Humanity's domination of nature is part of the problem: a response to Kareiva and Marvier. *Bioscience* 63, 241–242.
- Osmańczyk, J., Mango, A., 2003. *Encyclopedia of the United Nations and International Agreements*. Routledge, London.
- Palmer, C., 2009. Harm to species — species, ethics, and climate change: the case of the polar bear. *Notre Dame J. Law Ethics Public Policy* 23, 587–603.
- Perrings, C., Naeem, S., Ahrestani, F., et al., 2010. Ecosystem services for 2020. *Science* 330, 323–324.
- Pidgeon, A., Flather, C., Radeloff, V., Lepczyk, N., Keuler, N., Wood, E., Steward, S., Hammer, R., 2014. Systematic temporal patterns in the relationship between housing development and forest bird biodiversity. *Conserv. Biol.* 28, 1291–1301.
- Pimentel, D., Westra, L., Noss, R. (Eds.), 2013. *Ecological Integrity: Integrating Environment, Conservation, and Health*. Island Press, Washington, D.C.
- Pimm, S., Jenkins, C., Abell, R., Brooks, T., Gittleman, J., Joppa, L., Raven, P., Roberts, C., Sexton, J., 2014. The biodiversity of species and their rates of extinction, distribution, and protection. *Science* 344, 987–997.
- Primack, R., 2014. *Essentials of Conservation Biology*. 6th ed. Sinauer Associates, Sunderland, MA.
- Rands, M., Adams, W., Bennun, L., et al., 2010. Biodiversity conservation: challenges beyond 2010. *Science* 329, 1298–1303.
- Raven, P., Chase, J., Pires, J., 2011. Introduction to special issue on biodiversity. *Am. J. Bot.* 98, 333–335.
- Reid, W., et al., 2005. *The Millennium Ecosystem Assessment: Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington, DC.
- Rolston III, H., 1989. Duties to endangered species. In: Rolston II, H., *Philosophy Gone Wild: Environmental Ethics*. Prometheus Press, Buffalo, pp. 206–219.
- Rolston III, H., 1994. *Conserving Natural Value*. Columbia University Press, New York.
- Rolston III, H., 2010. *Three Big Bangs: Matter–Energy, Life, Mind*. Columbia University Press, New York.
- Rolston III, H., 2012. *A New Environmental Ethics: The Next Millennium for Life on Earth*. Routledge, New York.
- Sandler, R., 2012. *The Ethics of Species: An Introduction*. Cambridge University Press, Cambridge.
- Scott, S. (Ed.), 2006. *International Law and Politics: Key Documents*. Lynne Rienner Publishers, Boulder, Colorado.
- Secretariat of the Convention on Biological Diversity, 2010. *Global Biodiversity Outlook 3*. Montréal.
- Shaw, M., 2007. *What is Genocide?* Polity Press, Cambridge.

- Shen, G., Pimm, S., Feng, C., Ren, G., Liu, Y., Xu, W., Li, J., Si, X., Xie, Z., 2015. Climate change challenges the current conservation strategy for the giant panda. *Biol. Conserv.* 190, 43–50.
- Shoreman-Ouimet, E., Kopnina, H., 2015. Reconciling ecological and social justice to promote biodiversity conservation. *Biol. Conserv.* 184, 320–326.
- Smits, D., 1994. The frontier army and the destruction of the buffalo: 1865–1883. *West. Hist. Q.* 25, 312–338.
- Sodhi, N., Ehrlich, P., 2010. *Conservation Biology for All*. Oxford University Press, New York.
- Speth, G., 2009. *The Bridge at the Edge of the World: Capitalism, the Environment, and Crossing From Crisis to Sustainability*. Yale University Press, New Haven.
- Stanford, C., 2012. *Planet Without Apes*. Harvard University Press, Cambridge.
- Staples, W., Cafaro, P., 2012. For a species right to exist. In: Cafaro, P., Crist, E. (Eds.), *Life on the Brink: Environmentalists Confront Overpopulation*. University of Georgia Press, Athens, pp. 283–300.
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., Ludwig, C., 2015. The trajectory of the Anthropocene: the great acceleration. *Anthropocene Rev.* 2, 81–98.
- Stiglitz, J., Sen, A., Fitoussi, J.-P., 2009. Report by the Commission on the Measurement of Economic Performance and Social Progress. Republique Francaise, Paris.
- Sztybel, D., 2006. Can the treatment of animals be compared to the Holocaust? *Ethics Environ.* 11, 97–132.
- Terborgh, J., van Schaik, C., Davenport, L., Rao, M. (Eds.), 2002. *Making Parks Work: Strategies for Preserving Tropical Nature*. Island Press, Washington, D.C.
- Thoreau, H., 1989. *Walden*. Princeton University Press, Princeton.
- Tudge, C., 2000. *The Variety of Life: A Survey and a Celebration of all the Creatures That Have Ever Lived*. Oxford University Press, Oxford.
- United Nations Population Fund, 2012. *State of World Population 2012: By Choice, Not by Chance: Family Planning, Human Rights and Development*. United Nations, New York.
- Vucetich, J., Bruskotter, J., Nelson, M., 2015. Evaluating whether nature's intrinsic value is an axiom of or anathema to conservation. *Conserv. Biol.* 29, 321–332.
- Wall, D., 2013. Personal Communication with Author.
- Wilson, E.O., 2006. *Naturalist*. 2nd ed. Island Press, Washington, DC.
- Wilson, E.O., 2010. *The Diversity of Life*. Harvard University Press, Cambridge.
- Wilson, E.O., 2014. *The Meaning of Human Existence*. W.W. Norton, New York.
- Wohl, E., 2011. *A World of Rivers: Environmental Change on Ten of the World's Great Rivers*. University of Chicago Press, Chicago.
- Wood, A., Stedman-Edwards, P., Mang, J. (Eds.), 2000. *The Root Causes of Biodiversity Loss*. Routledge, London.
- Wuerthner, G., Crist, C., Butler, T. (Eds.), 2015. *Protecting the Wild: Parks and Wilderness*. The Foundation for Conservation. Island Press, Washington, DC.