The Next Mass Extinction: Human Evolution or Human Eradication

Andrew R. Jones, Ph.D.
California State University, Fresno, California

Abstract

The Earth is experiencing a sixth mass extinction, brought on by the proliferation of humanity and its activities of production and consumption. What distinguishes this extinction level event from previous....
Future Threats of Mass Extinction

Seventeen years ago, Harvard biologist Edward O. Wilson wrote of the “death of birth” in reference to the impact humans were having on biodiversity and the alteration of ecosystems that served as the “powerhouses” of speciation (Wilson, 1992). Seventeen years later, the International Union for the Conservation of Nature (IUCN) provided evidence that Wilson may have understated the extent of the problem. The activities and behaviors of humans will have long-term impacts on evolutionary processes and biodiversity, including the likelihood of extinction. We are in the midst of an extinction level event brought about by the activities of our own species, and the impacts of this mass extinction will affect the resilience of species and the form of biotic recovery from future mass extinctions (Meyers & Knoll, 2001). So profound are the effects of human behavior on biodiversity and evolutionary processes (Palumbi, 2001), some have labeled this the anthropocene era (Crutzen & Stoermer, 2000).

Extinction is part of the process of evolution - all species evolve to extinction (Lewontin, 2000). However, every so often, an event transpires which intensifies the rate of extinction well beyond what could be deemed ‘natural’ (Courtillot, 2002). Scientists have documented five such events, and many within the scientific community contend that we are in the midst of a sixth extinction (Thomas, et al., 2004; Gould, 2003; Chivian, 2001; Regan, Lupia, Drinnan & Burgman, 2001; Meyers & Knoll, 2001; Leakey & Lewin, 1995). This has been called the Holocene Extinction Event, brought about by the activities of humans and the proliferation of our species. Estimates of anthropogenic extinction range from 1,000 to 10,000 times greater than the natural rate of species extinction (IUCN, 2009) and these estimates may be overly conservative.

Depending on factors such as whether human production and consumption continues at its current rate, scientists predict a die-off of approximately one-third to two-thirds of all species (Baillie & Groombridge, 1997; Ehrlich & Wilson, 1991). The human race is not the first species to alter the biosphere through its activities with a resultant impact on other species’ viability, that distinction belongs to the photosynthetic organisms that produced oxygen to create the atmosphere on which all subsequent life has depended (Joseph, 2009a; Leakey & Lewin, 1995). However, the consequences for the future evolution of species will be profound. To fully understand the magnitude of humanity’s impact requires placing the current biotic crisis in historical context.

Prior to the evolution of macroscopic multicellular eukaryotes and the first metazoans, there may have been four mass extinctions of an unknown number of prokaryotic and microscopic eukaryotic species (Elewa & Joseph, 2009, Joseph 2009a). These have been referred to as the Paleoproterozoic (2.3 to 1.8 bya), the Sturtian (725 mya to 670 mya), the Marinoan/Gaskiers (640 to 580 mya), and the Ediacaran extinctions (540 mya), and with the exception of the latter, each was related to world wide periods of prolonged glaciation that developed over millions of years of time (Joseph, 2009a).

By contrast, the first mass extinction of complex animals (approximately 438-440 million years ago) may have involved rather sudden climate change, and wiped out approximately 25% of families (containing anywhere from several to thousands of species) of marine life. The second (360-370 m.y.a.) is speculated to have resulted from climate change, and eliminated 19% of families. The third (245 m.y.a.) appears to have involved a combination of climate change and a bolide impact, with a resultant loss of 54% of families. The fourth (208-210 m.y.a.) though as yet indeterminant in exact cause resulted in 23% of families lost. The fifth (65 m.y.a.) involved bolide collisions in conjunction with physical events (e.g., massive volcanic eruptions) and wiped out the remaining terrestrial dinosaurs (17% of families lost). Each event involved a combination of factors, e.g., a bolide impact in conjunction with climate change brought on by physical events, leading to mass extinction (Arens & West, 2008; Elewa & Joseph, 2009).

Each of these extinction events encompasses periods of punctuated equilibrium (Gould, 2002), with speciation and evolutionary development taking place rapidly, in geological time, such that, in terms of biomass, there was complete recovery within approximately three to eight million years of each mass extinction event (Gould, 2002; Sole, Montoya & Erwin, 2002; Sheehan, 1996). A number of interwoven conditions helped trigger rapid biotic recovery: empty niches which could be invaded and exploited, a diversity of flora and fauna, complex interaction between species, and the widespread presence of an ecosystem conducive to speciation (e.g., tropical rainforests). (Lewontin & Levins, 2007).

What differentiates the current mass extinction from all previous major and minor extinction events is the...
habitats, the isolation of species, and leading to a disruption of gene flow as even mating patterns are combined with the creation of transportation networks of roads and rail lines, results in fragmentation of habitat loss for countless numbers of species (Raup, 1991). wetlands for the purpose of agricultural production, resource extraction, and urbanization has resulted in Humans too, are invasive species. Alteration of vast areas of biomes such as tropical rainforests and of their habitat (Mooney & Hobbs, 2000). to easily disrupt ecosystems and eliminate other species through predation, inhabitants who are ill prepared to compete with foreign invaders. Species of flora and fauna face a multiplicity of extinction threats as a result of human proliferation and are depleted, the species which depended upon them, go extinct. Capitalism requires increased consumption. A successful business is a growing business, and to grow "punishment mechanism" for any attempts to reform it or transition to an alternate system of economic activity (Lindblom, 1977). Improving efficiency for the purposes of accumulation and expansion requires the reformation of human societies along market lines (Polanyi, 1944), and we have witnessed the growth in human population concurrent with the rise of industrial capitalism as a result of this transformation. The result of this “treadmill of production” is the intensification of the mass extinction currently underway (Schnaiberg & Gould, 1994; Schnaiberg, 1980). "...the true meaning of economy in the human situation cannot be other than economizing on a long-term basis. Today we find the exact opposite. The way in which the capital system operates makes a mockery of the necessity of economizing. Indeed, it pursues everywhere with utmost irresponsibility the opposite of economy: total wastefulness. It is this profit-seeking wastefulness that directly endangers the very survival of humanity” (Mészáros 2001, p. 99). It could be said that capitalism embraces and exemplifies the "Darwinism" construct of "survival of the fittest." Companies compete for markets and losers are devoured or go out of business (extinct). Capitalism requires increased consumption. A successful business is a growing business, and to grow requires more customers and the increased consumption of greater resources. When natural resources are depleted, the species which depended upon them, go extinct. Species of flora and fauna face a multiplicity of extinction threats as a result of human proliferation and consuming activity (Gaston & Fuller, 2007). Globalization of trade has provides a ready means for species to hitch hike over oceans and thousands of miles of territory, and to thus invade the territories of inhabitants who are ill prepared to compete with foreign invaders. Globalization enables invasive species to easily disrupt ecosystems and eliminate other species through predation, displacement, or destruction of their habitat (Mooney & Hobbs, 2000). Humans too, are invasive species. Alteration of vast areas of biomes such as tropical rainforests and wetlands for the purpose of agricultural production, resource extraction, and urbanization has resulted in habitat loss for countless numbers of species (Raup, 1991). Such transformation of landscapes, combined with the creation of transportation networks of roads and rail lines, results in fragmentation of habitats, the isolation of species, and leading to a disruption of gene flow as even mating patterns are...
Among many in contemporary society (Peterson, Maier, & Seligman, 1993) and what sociologists refer to as production of our food (Leslie, 1996). Reliance on technology has produced "learned helplessness" (Harris, 1997). "Waste" in the form of chemicals, pharmaceuticals, poisons, and the residue of all the drugs and hormones humans ingest then excrete, all of which flows to the oceans. Our oceans have become one vast toilet for the humans of this planet.

Anthropogenic climate change may prove to be the greatest threat of all for biodiversity and ecosystems (Parmesan & Yohe, 2003; Thomas, et al., 2004) A particular species may prove resilient in the face of one kind of threat (depending on factors such as range area, body size, population size, and reproductive rate), but the combination of all of them is more than that species can handle (Gaston, 2005; Isaac & Colishaw, 2004; McKinney, 1997; Soulé, 1980). Additionally, there is the issue of human population growth and population density, as the human population is predicted to reach nearly 10 billion by 2050 (Cohen, 1997, 2003). Increased population density is another significant threat for species extinction (Brashares, Arcese, & Sam, 2001; Cohen, 2003); and may even lead to the extermination of humans as they compete and eventually go to war over dwindling resources.

**Capitalism and the Extinction of Humans**

As long as capitalism, or any other economic system involving massive extraction of resources for production is intact, the current mass extinction will continue. While some theorists contend capitalism will be forced to internalize costs and become ecologically sustainable (Carolan, 2007; Mol, 2001; O’Connor 1997; Rosewarne, 2002), the dynamic quality of capitalism precludes this possibility. The rarity of a species merely makes it a greater investment opportunity in a system that commodifies all forms of life (Meyer, 2006). Ecological disasters are markets of opportunity, or as Marilyn Waring notes, "there is no debit side" for capitalism, given that the natural world is viewed by proponents of capitalism as a cornucopia (Lewontin & Levins, 2007; Finbar White, Rudy & Wilbert, 2007; Waring, 1999).

Returning to the concept of a market society, it stands to reason that the structuring of human activity and lifestyles in line with the needs of capitalism has produced much of the degradation and alteration of habitats and ecosystems for the species currently threatened with extinction (McKibben, 2005). Urban sprawl, deforestation, road building, and a host of other human activities now underway will produce more threats to the viability of plant and animal species.

**Nuclear War and Extinction**

An additional threat manifests in the form of global warfare. As resources become increasingly scarce, and human populations attempt to migrate away from areas deserted or inundated due to climate change, the use of military force to secure liveable space will come into play (Klare, 2001; McKee, 2009). The likelihood of this scenario is predicated on whether international efforts at cooperation in addressing our collective situation succeed or fail (Klare, 2009; Levy & Sidel, 2009).

Failure could result in the probable use of nuclear weapons, and chemical and biological agents to eliminate "problem" populations (Homer-Dixon, 2001). Be it the Khmer rouge of Cambodia, Hitler and the Nazis, the Armenian genocide, the purposeful eradication of the "Native Americans" and so on, history is replete with stark evidence of humanity’s willingness to exterminate their fellow humans. With nuclear proliferation and the increasing risk that "rogue states" or international terrorists will acquire and unleash weapons of mass destruction, it would be naive to believe that humans will not attempt to exterminate millions of their fellow humans again in the future. Dwindling resources, competition for clean water, gas, oil, and other commodities, may guarantee it.

However, there is the possibility that some limited rationality will prevail, and decision-makers opting for warfare may preclude the use of such weaponry, understanding that deploying such ordinance will destroy the very things they seek to access and control. However, even baring religious intolerance and racial hatreds, this possibility is unlikely so long as the voracious needs of the ever consuming capitalist system continue to dominate decision-making (Mészáros, 2001). Nor can we hope that democratic governments might prevent these capitalistic catastrophes, for the simple reason that capitalism also thrives in totalitarian environments. Nazi Germany and modern day "communist" China, are proof of that.

Assuming humans continue the current pattern of economic competitive consumptive behavior, we can readily predict that the massive rate of species extinction will in fact accelerate until the human race destroys itself, or is so greatly reduced in numbers that their impact will be negligible. The impacts of the human species, resulting from our behaviors encompassing only a few centuries, will have long-term repercussions for speciation and diversification.

**The Extinction of Humanity**

All species evolve to extinction, and humans are no exception. More than likely, the demise of our species will not be the result of a single cataclysmic event (it is debatable whether our species will survive the Holocene Extinction), but rather will involve a confluence of factors (Hallam & Wignall, 1997). Our current civilization is predicated upon the use of fossil fuels for both our energy needs and for the production of our food (Leslie, 1996). Reliance on technology has produced “learned helplessness” among many contemporary societies (Robeco, Mans, & Collins, 2009) and what sociologists refer to as “productive alienation.”
mechanisms which govern metamorphosis (Joseph, 2000, 2009a,b). The theory of “evolutionary metamorphosis” likens evolution and extinction to the same genetic

longer “fit” and they were selectively eradicated whereas birds, flowers, insects, and mammals survived. Therefore, long before the demise of the dinosaurs, major evolutionary innovations and developments had already taken place, to the mutual advantage of plants, insects, birds, and mammals who began to proliferate. Yet, these evolutionary innovations also dramatically altered the habitat of the dinosaurs and so reduced their ability to thrive that when catastrophe struck, dinosaurs were unable to survive. For example, there is considerable evidence indicating dinosaurs were plagued by the growing swarms of blood-sucking, disease-carrying insects (Poinar and Poinar 2008), and conventional wisdom has been that as mammals and possibly birds proliferated, they feasted upon the eggs of these “terrible lizards” and Anchiornis huxleyi (Hou et al., 2009; Xu et al., 2009) transitional species between dinosaur and bird, had begun to coevolve at an accelerated pace, with flying insects and Archaeopteryx/Anchiornis sharing the skies with flying reptiles Pterosauria/pterodactyls (Naish & Martill, 2003; Wang et al., 2008), flowering plants, flying insects, and Archaeopteryx (Elżanowski, 2002; Naish & Martill, 2005; Skakkebaek, Jørgensen et al., 2006; Weinhold, 2004; Wilson, 2000).

The history of the world tells us that all species will eventually become extinct. We should not believe that humans might be the exception. Even the steps we take to improve life and the health of humanity, contributes to our eventual demise. For example, we have a greater vulnerability to infection, owing in part to the development of drug-resistant strains of bacteria we helped to evolve as a result of widespread use of anti-bacterial products and over-use of antibiotics (Arias & Murray, 2009; Platt, 1995; Weinhold, 2004). Then there is the proliferation of vectors for disease resulting from climate change (Tol & Dowlatabadi, 2001). And what might be the long term consequences of the chemicals, poisons, and hormones released into the environment and the water we drink and the air we breathe? Thus, we have created the conditions for our own demise, as well as the mass extinction of other species.

Evolution and Extinction: Predicting the Future

What predictions can be made about the aftermath of the next mass extinction and the human condition?

Darwin (1859, 1871) has hypothesized that evolution proceeds by “small steps” and is governed by natural selection acting on random variations. Darwin’s emphasis on “small steps,” however, is at variance with the fossil record (Gould, 2002) and his theory does not lend itself to making predictions, except in the most general of terms: survival of the fit. Unfortunately, we cannot predict what is “fit” vs “not fit” until an extinction event determines the outcome for us.

Extinction events are accompanied by bursts of evolutionary innovation and speciation (Gould, 2002; Joseph, 2009b). Each of the five major eukaryotic extinctions are typified by the emergence of new species which in many ways only superficially resembled their ancestors; except as pertaining to commonalities in DNA (Joseph 2009a,b).

Therefore, based on the fossil record and Gould’s (2002) theory of “punctuated equilibrium,” we can predict that the next extinction event will also be characterized by quantum leaps in evolutionary development.

To more precisely determine the nature of the next quantum leap and what evolutionary innovations might transpire, we can obtain important hints from what led up to the last major extinction and the impact on the survivors.

Beginning around 150 to 130 mya, almost seventy million years prior to the demise of the dinosaurs, flowering plants, flying insects, and Archaeopteryx (Elżanowski, 2002; Yalden, 1984) and Anchiornis huxleyi (Hou et al., 2009; Xu et al., 2009) transitional species between dinosaur and bird, had begun to coevolve at an accelerated pace, with flying insects and Archaeopteryx/Anchiornis sharing the skies with flying reptiles Pterosauria/pterodactyls (Naish & Martill, 2003; Wang et al., 2008), who had taken to wing yet another hundred years before (220 mya).

Insects, plants and birds, share common ecosystems and a complex interrelationship. Birds and insects feed on flowering/fruiting planets, and both assist in ensuring that pollinating plants breed and continue to reproduce with birds not only spreading pollen but the seeds they eat. Birds feed on insects, and some plants feed on insects, birds, and even small mammals (Barthiott et al., 2007). The physiology of plants and insects show the clearest evidence that both coevolved (Schoonhoven et al., 2006). However, yet another beneficiary were fruit eating mammals.

Therefore, long before the demise of the dinosaurs, major evolutionary innovations and developments had already taken place, to the mutual advantage of plants, insects, birds, and mammals who began to proliferate. Yet, these evolutionary innovations also dramatically altered the habitat of the dinosaurs and so reduced their ability to thrive that when catastrophe struck, dinosaurs were unable to survive. For example, there is considerable evidence indicating dinosaurs were plagued by the growing swarms of blood-sucking, disease-carrying insects (Poinar and Poinar 2008), and conventional wisdom has been that as mammals and possibly birds proliferated, they feasted upon the eggs of these “terrible lizards” and harassed and ate their young. When calamity struck, 65 million years ago, the dinosaurs were no longer “fit” and they were selectively eradicated whereas birds, flowers, insects, and mammals survived.

The theory of “evolutionary metamorphosis” likens evolution and extinction to the same genetic mechanisms which govern metamorphosis (Joseph, 2000, 2009a,b). The quantum evolutionary leaps
which punctuate equilibrium (Gould, 2002), therefore, are also under genetic regulatory control. Just as a "fish-like tadpole" can undergo a complete physical metamorphosis, new species may emerge which bear no resemblance to their direct ancestors, except at the level of DNA (Joseph, 2009a).

Our lesson from the past is this: some species of dinosaur also underwent a complete transformation; they grew feathers and became birds (Hou et al., 2009; Xu et al., 2009).

Therefore, we can make certain predictions about the next extinction event which is: if humans become extinct, what emerges in our place may be as different and, on the surface, as unrecognizable as the link between dinosaurs and birds.

Further, we can predict that humans may engineer their own extinction. What may evolve in their place will depend on how and the manner in which humans eradicate themselves. 


In the event of a world-wide nuclear war, the human species and most "higher" mammalian animals would likely eventually become extinct. The survivors would include "weed" species (Meyers & Knoll, 2001); single celled prokaryotes, microbial eukaryotes, and some species of plants and insects which eventually would likely recover, diversify, flourish, and undergo rapid and quantum evolutionary change.

Insects are survivors. Winged insects, such as the dragonfly have a pedigree extending 200 million years into the past and they are remarkably similar, physically with their most ancient of ancestors with one outstanding difference: some of the earliest dragonflies were nearly three feet in size, with a wingspan of 30 inches (Wilson 1974).

Some insect societies, such as ants, are highly sophisticated, and include divisions of labor, a caste system, altruistic cooperation, complex communication, insect agriculture, the growing of food, weaving, building, the "domestication" of other insects which they corral and milk and eat; and like humans they war against one another and conquer and kill and enslave (Hölldobler & Wilson, 1998; Wilson 1974).

Insects and humans also share core sets of genes which can be traced to common ancestors (Joseph 2009b). Further, genes, including those which can be considered "human" are subject to lateral gene transfer, with genes commonly exchanged between species (Joseph 2009a,b).

Therefore, we can predict that with complete eradication of humans, components of the human genome will live on within the genomes of insects who already posses many "human" attributes. However, we should not expect to see the development of any large vertebrates during the ensuing biotic recovery (Meyers & Knoll, 2001; Franklin & Frankham, 1998).

Since most of the human and insect genome is "silent" and contains thousands of shared genes which have not yet been expressed (Joseph 2000b), we can predict that these genes may come to be expressed within the genomes of future species of insects. If humans become extinct, social-communal living insects may grow in size, undergo physical transformation and evolutionary quantum leaps, possibly losing their characteristic "insect" physique, and advance to and achieve ever heightened levels of communal, cultural, and intellectual achievement. They may only superficially resemble the insects we know today and be as different as birds and dinosaurs or egg laying mammals vs modern humans.

Genetic Engineering, Designer Babies, and the Eradication of Humans.

Humans have acquired the DNA-technology to screen the human fetus for genetic defects, and to chose the sex, eye and hair color of their babies.

If humans do not self-destruct in a world-wide nuclear war, we can predict that within the next thousand years humans will have acquired and will employ the technology to genetically design babies who are more handsome, beautiful, athletic, and intellectually far superior to their parents.

Naturally, the rich, famous and powerful would be the most likely to afford and the first to employ this genetic-technology. These first generations of genetically altered humans would be few and far between and members of the privileged class.

It is not unreasonable to assume that these intellectually superior designer babies of the future, would develop technologies superior to those of modern humans. Using their greater genetically-enhanced intelligence, they may genetically design their own babies who presumably would do the same to their own infants if not to their own bodies and brains (Joseph, 2000).

Therefore, in a few hundred years, or maybe within just a few generations, a small select group of "humans" may genetically engineer their own evolution, and undergo such rapid evolutionary change that they become as different from modern humans as birds are from the dinosaurs; yet with one additional troubling difference.

From the perspective of modern humans, the genetically altered humans of the future may become so technologically and intellectually advanced, that they may appear as "gods," whereas modern humans might appear no better than reptiles in comparison (Joseph, 2000).

From the perspective of the first, second, or third generation of designer babies, the bulk of humanity might not only appear as inferior and primitive but as hungry, all consuming competitors for diminishing resources...
resources. Therefore, we might predict that the genetically, intellectually enhanced designer babies of the future might decide to completely eradicate and exterminate the last of “modern” humanity, and this is how humans, as we know them, finally become extinct.

Conclusion

Astronomers predict that within a billion years, the Earth will no longer support life due to increased solar activity, with the sun heating up and expanding as it enters into a red giant phase, vaporizing our atmosphere and oceans, and extinguishing all complex life forms (Schröder & Smith, 2008; Silvotti, et al, 2007) with the possible exception of microbes dwelling deep beneath the Earth and those blown to safety and who survive in a growing nebular cloud.

If humans survive, it will only be because they genetically engineer their own evolution, and migrate to worlds in distant solar systems. All complex life forms left behind, will die. Thus when the Earth is finally consumed by the fires of the expanding sun as it enters its red giant phase, the microbial ancestors of those microbes who first arrived on our planet over 4 billion years ago, will inherit our dying planet, and these survivors will be the only life forms left to witness the end.

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Best Answer: Humans are causing the current mass extinction event. It's called the Anthropogenic Holocene Extinction Event. > After previous mass extinctions, what typically happens? During the next ten million years or so, the surviving lineages undergo evolutionary radiation to fill the niches vacated by the ones that went extinct. Â > In what way are humans currently affecting the process of evolution and extinction? o Obviously species that become extinct aren't going to leave any descendants to further evolve. o Some species will inevitably evolve to better fit in a world with humans. These include dogs, cats, horses, pigs, corn, wheat, lettuce, radishes but also brown rat, house mouse, mealworms, crickets, c-ckroaches. While extinction of population, genetic lineages or entire species are a common occurrence in the history of life, mass extinctions - brief times of
crisis where both the amount and diversity of life sharply drop - are few events of huge importance that shape the history of a planet. Despite the huge capacity for adaptation displayed by life, a rapid change in environmental conditions can bring the general extinction rate far above the speciation rate. Since the vast majority of biomass and Indeed, there have been 5 mass extinctions throughout the history of life on Earth, but there is a key difference between these past events and what is happening presently: humans are almost entirely to blame for the current mass extinction. Climate change, pollution, deforestation and overharvesting are all contributing factors. Loss of megafauna has various downstream effects and may eventually impact human health. For example, studies conducted in Kenya where patches of land were isolated from large animals such as zebras and elephants found that the areas rapidly became plagued with rodents due to increases in food availability and shelter.