Animals and Climate Change

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Climate change represents an unprecedented threat to animal life on Earth, brought about by a single species: humanity. It is well-known that humans will suffer greatly as a result of continued climate change over the coming decades and centuries, but the calamitous effects on other animals are often downplayed. Here, the origins and potential scope of climate change are explored and the implications for the whole animal kingdom are summarized. It is argued that humans, as part of this kingdom, have both a responsibility and an imperative to take immediate steps to avert climate change for the sake of all animal life.

Key Words: climate change, climate, extinction, pollution, exploitation, animal rights, injustice

In 2014, the World Wildlife Foundation (WWF) published a report on the state of Earth's animals. The report enjoyed a brief blizzard of media attention, largely because of one damning statistic: Across the 3,038 species of vertebrate animals they studied, the authors recorded a staggering 52% decline in overall population between 1970 and 2010 (WWF, 2014). Most of this loss was attributed to exploitation by humans and habitat degradation and destruction; only 7% was attributed to climate change. But a period of extensive, widespread change to the global climate brought about by ongoing human activities is, as far as scientists can tell, only just beginning. As this process--what we shall refer to hereafter as climate change or global warming--continues to worsen, it will become increasingly difficult for animals to cope with the

changes to living conditions, including average temperature and rainfall, that it will directly entail. But climate change will also have profound indirect effects on animals by worsening other stress factors, such as habitat destruction, and could thereby become the most important contributor to animal suffering and death. In this article, the origins, possible scope, and implications of climate change are explored, and it is argued that we as humans have a duty, in light of these facts, to do whatever we can to avert it.

Global climate change is unique in its ability to cause such a large variety of animals to suffer--including, of course, ourselves--right across the planet. There can be no escaping it on land, in the skies, or in the seas. It could lead, for the first time in the 600 million year history of animal life, to a mass extinction brought about by a single species, the human. It is far from unusual for life-forms to influence Earth's climate, which can be defined as the weather conditions such as temperature, rainfall, and so on in each region of the planet averaged over months and years. James Lovelock (2000), with his famous "Gaia Theory" published in the 1970s, made the most pressing case for a strong interdependency between Earth's climate and surface conditions and the organisms that live upon it. Not only has life's evolution been shaped by its environment: The planet's temperature and chemical composition at the surface, its weather, and its geology have all been tailored over the eons by living organisms to make it more habitable. Earth is not only a static platform upon which life-forms develop, but rather a dynamic world in which life flourishes, adapts, and brings about changes that in turn influence the development of present and future organisms.

Human-induced climate change is only the latest instalment in this long-running story of life-induced change. Simply by coming into existence as part of the web of life, humans have from our beginnings inevitably contributed to some sort of climatic change. The rise of

civilization, settlements, and farming, and our unprecedented spread across nearly all of six continents have perhaps made our influence on the climate especially significant compared to that of other animals over the last several thousand years, and there can be no doubting that we have been tremendously successful in altering the planet to meet our own needs over this period.

But the human-induced, or "anthropogenic," climate change that we are now experiencing in the wake of the industrial revolution is of an entirely different magnitude, and it has profoundly more serious implications for the animal kingdom. The reason is that where previously our species made local changes to our landscapes--clearing a stretch of forest, say, and cultivating fields of domesticated crops--that tended to have only local effects on the climate, now our pollution is also beginning to have global climatic effects. In ages past, humanity tended to work alongside the rest of nature, trying to exploit its animals and plants to our own ends but at the same time recognizing our utter dependence upon the natural world and the need to preserve other species and the essential regenerative cycles in which they participate. Now, by contrast, industrial farming and manufacturing have enabled most of us to ignore other species and forget our dependence upon them. Distanced from the land and our own natural habitat, we are to varying degrees blinded to the harm that we are doing to other species and their habitats by vice of our industrialized lifestyles.

An animal's habitat is essential to its existence: Destroy it, and we destroy the animal's capacity to survive. This habitat comprises the conditions to which that animal has adapted evolutionarily, including the local climate. That is why the three greatest threats to animal life after direct exploitation by humans, "climate change," "habitat destruction," and "habitat degradation," are so difficult to disentangle. Climate change is nothing other than habitat destruction, perpetuated on a far greater scale than humanity has ever been capable of achieving

before. It has the capacity to damage habitats left untouched until now by human hands, from deep rainforest to pristine Arctic ice. Therein lies its devastating capacity to harm animals. Today's climate change is more pervasive than any such change previously brought about by life on Earth. But it is also unprecedented in its rapidity, leaving animals with little time to adapt to changing conditions and avoid extinction. Evolution is usually a gradual process, a colorful story of diversification whose changing hues only become apparent on millennial timescales. Anthropogenic climate change is happening on the scale of years and decades. In just the last half-century, we have witnessed a global average temperature increase of 0.8 degrees Celsius (Hansen et al., 2013).

This may not sound like very much, but placing it within the historical context illuminates just how significant a global change of this magnitude over such a short time really is. It is true that Earth's temperature has been much higher in the past. Three million years ago, at the height of the Pliocene geological epoch, the global mean temperature was at least 3 degrees higher than it is today. Sea levels were around 25 meters higher, and there was no permanent ice on Earth. Conditions for life were therefore very different. But at the end of that epoch, Earth gradually transitioned to a cooler state--the "Ice Age" in which we are now living--with permanent ice at the poles. For the last 2 million years, Earth's orbit and changes in its axial tilt have caused it to oscillate between "glacial," colder periods, and "interglacial," warmer periods. Earth has been in an "interglacial" for the past 10,000 years, so although it has been repeatedly several degrees colder than at present in "glacial" conditions, it has not been very much warmer than today since the Ice Age began. That means that today's animal life is much more likely to be able to adapt to abrupt changes that bring colder conditions than warmer ones.

In the current 10,000 year interglacial period, the highest that global average temperature has been is around 1 degree Celsius higher than what it was before the industrial revolution. For the world to have warmed by nearly this much in just a few decades is therefore very concerning. At the 2010 United Nations climate conference in Cancun, negotiators agreed to set a global average warming of 2 degrees above preindustrial temperatures as the target for future actions to tackle climate change (United Nations Framework Convention on Climate Change, 2011). A temperature as high as this has not occurred since the previous interglacial period, over 120,000 years ago. If we take this (some might say optimistically) as the basis on which to estimate how much the planet will warm this century, the prospects for animal life look grim. At this pace, such climate change is more akin to the devastating asteroid impacts and supervolcano eruptions that have been blamed for the mass extinctions that take place every few hundred million years than to the natural fluctuations of the current Ice Age.

There can be little doubt that humans are to blame. The warming we have seen since preindustrial times is caused by human emissions of greenhouse gasses, especially carbon dioxide, a theoretical model that we can confirm by looking to the historical record. Using the air trapped in ice sheets, it is possible to track temperatures and carbon dioxide emissions over the past 800,000 years. Until preindustrial times, carbon dioxide lagged behind temperature--whenever Earth got warmer, for instance, carbon dioxide was released by the oceans, increasing its concentration in the atmosphere. Carbon dioxide amplified the warming, but it did not cause it. Today, the same graphs show quite a different story. Carbon dioxide levels are now rising ahead of global average temperature, showing that the gas is, at least in part, the cause of the warming. Smaller contributions come from other gasses that our activities release, such as methane and nitrous oxide. But the Intergovernmental Panel on Climate Change (IPCC; 2013),

which brings together climate scientists from around the world, is more than 95% certain that most of the warming of recent decades is caused by human greenhouse gas emissions.

The origins of climate change are important when it comes to predicting its implications. On the face of it, we might expect animals to be able to adapt to a world that is 2 degrees warmer, since this temperature is not in itself without precedent. But what is new is the rate of the warming from human emissions. This, combined with other human pressures that prevent animals from adapting to or escaping from climate change, is what could be lethal. As well as causing direct harm, climate change exacerbates existing problems of habitat destruction, disease, pollution, and invasive species, all of which have been implicated in the vertebrate decline reported by the WWF. Even a 2-degree rise in global average temperatures could cause a catastrophe of extinction and suffering (Hansen et al., 2013). If emissions continue to rise unabated and the world misses this target, feedbacks could be set off that push temperatures far higher, with disastrous consequences.

Climate change directly affects animals in numerous ways. The overall global warming--the figure that the UN wants to restrict to 2 degrees or less--is not equally distributed across the planet. Some regions, especially the Arctic, are already experiencing dramatic warming of several degrees in places, while others are changing hardly at all. Where the warming is greatest, animals are faced with a struggle to adapt to a sudden increase in temperature or to migrate to cooler regions. The extent to which this is possible varies between species. If the warming is very rapid compared to the reproductive timescale of the species, it is unlikely that they will have time to adapt, while migration is restricted in many areas by human infrastructure, farms, and cities that make the situation much worse for animals today than those facing similarly extensive but less rapid climate change hundreds of thousands or millions of years ago. To give just one

out of countless possible examples, the American Pika, a small mammal living in the mountains of North America, will be forced to migrate to higher and higher ground as temperatures rise. Eventually, it will not be able to climb any higher, temperatures will become unbearable for the remaining individuals, and the species will die out.

In the Arctic, of course, there can be no question of species escaping to higher, cooler latitudes, and animals adapted to life on the ice are unlikely to survive when the ice caps melt entirely for the first time in millions of years. The last polar bears will suffer a painful death, enduring heat stress and starvation as their icy paradise melts away. Two degrees of warming would be enough to render the Arctic ice-free in the summer (Hansen et al., 2013); runaway warming to pre-Ice-Age temperatures would catapult us into an ice-free world.

The melting of the ice sheets will not only have profound effects on animals living at the poles. Sea level rise, caused by a combination of runoff from ice sheets melting over land and warming waters (water expands as it warms), has been evident since the early 20th century, with global average sea level increasing by 0.19 m between 1900 and 2010 (IPCC, 2013). Rising seas will destroy coastal animal habitats, including those of humans. Worse, the loss of cities and farmland at the coasts, as well as causing a great deal of suffering for coastal human communities, will increase the pressure on people to develop inland animal habitats for farming and housing that would otherwise have been left undisturbed. Tigers in Bangladesh and India are one species especially at risk from this, living in a low-lying region where the human population is rising almost as fast as the sea.

Because Earth's weather systems are all closely interconnected, warming the planet will also affect rainfall patterns across the world. In general, drier regions are expected to become drier, and wetter regions wetter, exposing animals to abruptly more intense extremes.

Desertification will render once habitable regions insufferable to many animals, and numerous individuals will suffer as a result of increasingly prevalent forest fires, which threaten the survival of species such as the Malaysian orang-utan. Some climate models predict that the Amazon rainforest, probably the most biodiverse place on Earth, will get drier and possibly die off entirely (Mahli, et al., 2009). Two degrees of warming, combined with the pressure of human exploitation, could transform this lush paradise into a dry desert. Furthermore, the Amazon is a vast "carbon sink," drawing down huge volumes of carbon dioxide from the atmosphere and locking it away through photosynthesis. An Amazon dieback would transform it from sink into source as burning and decaying trees and exposed soils release this locked-away carbon back into the atmosphere. That would in turn accelerate climate change for the rest of the globe.

It would also mean the suffering of countless birds, mammals, insects, reptiles, amphibians, and native people dwelling in the forest. The Amazon is estimated to contain 10% of the world's animal species, but it is critically dependent on the cycle of wet and dry seasons that climate change could interrupt. Many of those species will therefore become extinct without our ever being able to study them or appreciate their unique beauty as part of the animal kingdom.

It is not just on land that animals will suffer. The oceans absorb both heat and carbon dioxide from the atmosphere--indeed, they have absorbed around half of all our greenhouse gas emissions since the industrial revolution, helping to mitigate the climate change we have experienced to date. The devastating effects of this are already becoming clear. Species of fish are having to migrate to cooler waters to escape the heat: The red mullet for instance, once found only in Mediterranean waters, is now displacing cod off the British coast. Perhaps more important still than ocean heating is ocean acidification caused by the absorption of carbon

dioxide. This makes it difficult for some species of fish to reproduce, but has a yet more debilitating effect on calciferous organisms that build shells and skeletons from calcium carbonate dissolved in seawater. As carbon dioxide levels rise, the ocean becomes more acidic and carbonate concentrations fall, and these animals are unable to grow. Coral is the most famous example. Its reefs, known as the “rainforests of the oceans,” are themselves a habitat that supports some 4,000 species of fish alongside other small marine animals. But up to 20% of the world’s corals have died out in recent decades (Wilkinson, 2004), and this figure will only increase as climate change worsens. While air temperatures naturally fluctuate from week to week and season to season, ocean temperature and acidity is generally much more stable, especially in the shallow tropical seas where corals live. That makes them especially sensitive to sudden changes in conditions that could force them into a dormant or dead state that leaves the millions of other animals they support homeless and another of the world’s paradises reduced to dust.

It has only been possible to provide here a few examples of the devastating implications of climate change for the animal kingdom. It will affect almost every species to a greater or lesser extent. Climate change represents a contravention on the part of humanity of the right to life and a healthy environment to which all sentient animals are surely entitled. If the purpose of all life is to experience the joy of existence alongside other creatures, we have both a duty to redress this violation and an interest in protecting our fellow beings by not exposing them to any greater suffering than they would naturally experience. Delighting in the diversity of life on Earth, humanity should strive to protect habitats wherever possible. In climate change we see the antithesis of this duty and delight: A misguided meddling with environments and habitats across the world that will cause widespread, lasting suffering so that humans can take transitory

pleasure in the unnecessary luxuries that our greenhouse gas emissions enable us to have. None of these, surely, can compare to the splendor of the natural world that we endanger in the process.

Humans are themselves a species of animal that will suffer just as much as any other as a result of climate change. Our own habitat is under threat, and it will be a miserable existence for us all when we witness cherished and much-needed species of animals and plants dying out and a lesser diversity of invasive species taking their place. For these relatively few species, climate change is good news. Coral reefs, rainforests, and big cats might all be a thing of the past in a warmer world, but rats, bedbugs, and mosquitoes will continue to thrive. Diseases currently endured only in the warm tropics may spread, borne by vectors such as mosquitos as they move into regions previously too cold for them to inhabit. Many of the “ecosystem services” we depend on will cease to deliver when these ecosystems are destroyed. Meanwhile, extreme weather events such as floods and storms will endanger our lives and infrastructure, low-lying farmland and cities will be inundated by rising seas, and billions of people will suffer from displacement or starvation when crops fail. Our lives will become much less comfortable and our world much less interesting, and all because of the pollution that humans have carelessly spewed to provide the goods and services that were supposedly making our lives more comfortable. Such is the irony of climate change.

Another irony concerning animals and climate change is that a large proportion of the greenhouse gas emissions that will make life so much more difficult for animals is associated with animal abuse on the part of humans. The rearing of animals for meat directly causes them to suffer--especially where those animals are kept in factory-style conditions--and is also a major contributor to the destruction of habitats such as the Amazon rainforest. But the vast herds of

ruminant animals such as cows and sheep also release copious amounts of methane, a greenhouse gas 20 times more potent than carbon dioxide that has contributed around 20% of postindustrial global warming (Jardine et al., 2006). It is largely because of this methane and the fertilizers used to grow animal feed that meat production contributes 14% of annual greenhouse gas emissions (Steinfeld, et al., 2006). Producing 1 kilogram of beef releases emissions equivalent to driving 160 miles in a typical car (Fiala, 2008). Feeding the world on a vegetarian or near-vegetarian diet would avoid nearly all these emissions, avoid bringing into the world millions of animals that live only to suffer and die for their meat, and free up huge swathes of land currently used to graze livestock or produce their feed, since much less land is required to produce the same amount of food from plants instead of animals. What is more, such a change would probably be beneficial for human health (Eshel & Martin, 2006).

The injustice of climate change is similarly evident. It cannot be fair that people living in less industrialized areas where conditions are already relatively extreme will suffer most immediately and severely from this problem, despite having played the smallest part in its causation. But the industrialized world is nevertheless far from immune to climate change, as the increased incidence of extreme weather events including forest fires in Australia, storms and droughts in North America, and floods and heatwaves in the United Kingdom and Europe in recent years demonstrate. Furthermore, we as polluters must bear the emotional discomfort of knowing that our pollution is responsible for such extensive suffering elsewhere in the world.

Climate change is the biggest threat to life on Earth since the last mass extinction of life took place 65 million years ago. The difference this time is that it is caused by a single species--humanity--which has within its power the ability to avert this looming catastrophe. Like all previous extinctions, it will not mean doom for the planet in the long-term. Animals have

adapted to large changes in the past, and life always bounces back to become just as diverse and widespread as before. But if we devastate life on Earth, it will take many millennia before it again flourishes to the same extent, and whether any given species--including humans--will still exist to witness its recovery cannot be predicted. In the meantime, there is little consolation for the billions of individuals who will endure great suffering over the coming decades and centuries. That diverse life will eventually recover from the storm certainly does not excuse the reckless pollution and destruction wrought by humanity in this industrial age.

It is our duty, therefore, to do whatever we can now to stop emissions. By leading less destructive lifestyles, consuming less meat and electricity, travelling and manufacturing less, and developing sustainable, renewable technologies, we might stand a chance of keeping global average temperatures below 2 degrees above preindustrial levels and minimize the harm done to animal life. It is in the interests of countless individuals, present and future, that we put all our efforts into doing so. After all, it is far better, surely, to give up a few consumer goods, flights, and meaty meals today than to sacrifice the life and well-being of countless animals, human and nonhuman, tomorrow.

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