

## Plants, Animals, Oceans, Ice, Land, People, Population, & Justice

In this section, we are going to take up greenhouse gases.

If you leave your car with its windows up in the sun on a comfortable 75-degree day, within 30 minutes the temperature in the car can rise to 109 degrees. This is how a greenhouse, which traps solar radiation, works. (It is also why you should never, ever leave your pets in a car on a sunny day with the windows up!)

When we talk about the "greenhouse effect," we are referencing how the earth's atmosphere (and certain gasses in particular) allow solar radiation to heat our planet.

Even though our atmosphere is an incredibly thin layer (a single layer of lacquer on a basketball would be proportionately thicker), it nonetheless keeps our planet warm.

CO<sub>2</sub>, methane, and other gases are called "greenhouse gases" because they all contribute to the greenhouse effect. Greenhouse gases are not in themselves bad. Without them, earth would be too cold to be habitable. However, because we have been pumping greenhouse gases into the atmosphere over the past 400 years (esp the past 60 years), our planet is quickly warming.

We initially referred to the impact that increased levels of greenhouse gases have on the planet as the "greenhouse effect," then as "global warming."

However, now that we realize that an increase in these atmospheric gases is changing our global climate in a range of ways, like hurricanes, more severe droughts, changes in regional weather patterns, etc., we refer to all this and global warming as "climate change."

More recently, we have yet another reconceptualization, as we now refer to what is happening as the "climate crisis."

For years, there was a reluctance among scientists and activist to seem like "alarmists." However, with people like Greta Thunberg unabashedly declaring that "our house is on fire," we no longer hesitate to describe what is happening as a true global crisis – which it is.

Knowing that I am interested in the climate crisis, people used to ask me when climate change was going to begin.

Unfortunately, questioning when global warming or climate change is going to begin is misguided: It has already begun.

Since 1880, average global temperatures have risen by a little more than 1° Celsius (around 2° Fahrenheit) total, with an average rise of about 0.08° C (0.13° F) per decade during this time. However, since 1981 the increase is now double this rate at 0.18°C (0.32°F)

Climate change is now impacting the entire planet and all life on it. No place on the face of the globe will be left untouched, from the upper limits of the atmosphere to the deepest ocean floors.

Let's consider how the climate crisis is changing our planet and its life.

The earth has experienced five major extinction events where 75% or more of all animals on the planet died off in a relatively short period. While most people are familiar with the fifth extinction event, which killed off the dinosaurs 66 million years ago, #3 is of special interest in terms of climate change.

252 million years ago, the Permian–Triassic extinction event was caused by some sort of major eruption, perhaps a volcano. Whatever the cause, increased CO<sub>2</sub> levels quickly caused global temperature to rise by 5° Celsius, which initiated a cascade of events, such as the rise of methane.

During the Permian–Triassic extinction event, 97% of all life on earth died. In comparison, "just" 75% of life on earth died during the Jurassic event that killed the dinosaurs.

Estimates suggest that we are currently adding CO<sub>2</sub> to the atmosphere at least 10 times faster than happened during the Permian–Triassic extinction event. Since the temperature of the earth has already increased by 1° Celsius, we are 20% of the way toward the conditions that brought about the most extreme extinction event in the earth's history.

As a consequence of this and other factors (such as habitat loss), experts suggest that we are now in the midst of our planet's sixth extinction event. The 2014 book *The Sixth Extinction: An Unnatural History* by Elizabeth Kolbert, which won a Pulitzer Prize, is a compelling and an excellent introduction to this issue.

The U.N. Convention on Biological Diversity estimates that: "Every day, up to 150 species are lost." In other words, over 50,000 species are becoming extinct every year. As Kolbert notes, this is perhaps 10,000 times the normal rate of extinction.

Although the extinction rate is itself disturbing, it only tells part of the story, as the overall number of extant animals on the planet has been dramatically reduced by human action.

So, here's a pop quiz: What do you think weighs more?

- a) All the wild mammals, birds, reptiles, and amphibians on the face of the earth - by a lot.
- b) All the wild mammals, birds, reptiles, and amphibians on the face of the earth - by a little.
- c) Human beings and our animals (livestock & pets) - by a little.
- d) Human beings and our animals (livestock & pets) - by a lot.
- e) I am not sure.

All the wild mammals, birds, reptiles, and amphibians on the face of the earth constitute just 3% of the planet's animal biomass. Human beings and our animals (livestock & pets) constitute 97%.

While estimates vary, there are around 900 million dogs and 600 million cats on earth. This pales in comparison to livestock. We maintain a global herd of about 70 billion (with a "B") livestock animals for food and other products. This translates into 10 livestock animals for each human being on earth.

However, this is misleading, as certain people (especially in wealthier countries) consume far more meat than others. In the US, per capita meat consumption is 265 pounds per year. In Bangladesh, it is 4 pounds per year.

In any event, faced with climate change and other human-caused issues, like loss of habitat, plants and animals have three options:

- 1) to adapt (evolve)
- 2) to move (migrate)
- 3) to die

Let's consider these options.

1) Adapt: For the past 30 million years or so, the earth has been cooling - thanks to all that CO<sub>2</sub> safely sequestered in fossil form underground. During that time life on earth was able to evolve to thrive in the changing, cooler climate. Given enough time, life can dramatically evolve. In less than one tenth that time, human beings evolved from a small primate the size of a chimpanzee (Australopithecus - Lucy) to us.

Unfortunately, contemporary anthropogenic climate change is happening far too quickly for most species to evolve in response. Leaving them with the next two options:

2) Migration: Half of life on earth (plants and animals) is now migrating in response to anthropogenic climate change. For the most part, the migration is toward the poles and cooler temperatures. On land, the average migration rate is 10 miles per year. Ocean life is moving four times faster.

However, life near the North Pole is often moving south as the ice sheet breaks. Polar bears moving down and grizzly bears moving up recently collided and have successfully bred. The first "pizzly" bear in the wild was discovered in 2006.

As life migrates toward the poles, it can have a range of consequences, some worrisome. For example, the Zika virus, which was first discovered in Brazil and which is often transmitted by mosquitoes that live in tropical regions, is now in the US.

Option #3: If life cannot evolve or migrate, the only option is to die. For example, coral (which is, in fact, an animal, even though it looks rather like a rock), which cannot move great distances and cannot evolve fast enough to adapt to rising ocean temperatures and increased ocean acidification (more on this later), are now dying across the globe.

Roughly half of the world's coral reefs have died in the past 30 years. Scientists predict that 90 percent of corals will die by 2050. Incidentally, the film *Chasing Coral* takes up this issue.

The loss of the planet's coral reefs has profound implications for life on earth. Life in ecosystems is deeply intertwined. 25% of our planet's marine life lives on (and depends on) coral reef ecosystems. Once the coral is gone, these ecosystems will largely collapse.

This is, of course, very bad news indeed for our oceans. It is also a problem for us human beings: Roughly one billion people rely on coral reef ecosystems for food, especially protein.

Our planet's oceans are performing an extraordinary service for us land animals and plants that has greatly reduced the impact of the climate crisis. If it wasn't for our oceans, the atmosphere would have risen for more than the its current 1° Celsius. Unfortunately, this is killing our oceans.

Over 90% of the heat from climate change has been absorbed by the oceans. Since the oceans are absorbing CO<sub>2</sub> where they are in contact with the atmosphere (which is over 75% of the planet), they are also becoming more acidic. Roughly 30 percent of CO<sub>2</sub> released by human action has been absorbed by the oceans.

Unfortunately, many plants and animals are sensitive to changes in acidity. Coral is a prime example. It is not just dying because of rising sea temperature, but also because of rising acidity.

Warmer air is now melting ice across the planet, such as the massive Antarctic and Greenland ice sheets. In addition, ice sheets over the ocean, such as the North Pole, are also melting because of warmer waters below. By 2050, ships will likely be able to sail over the North Pole.

Eventually, perhaps by the end of the century, the North Pole will be gone. This will only increase global warming, as the earth's ice sheets reflect heat back into space. In contrast, dark oceans absorb heat.

Thanks to all this melting ice, sea level will certainly rise over the next century. Conservative estimates are that it will rise by at least one meter (39 inches). Some estimates are for a rise of ten feet, three times that amount.

Since a third of the world's cities are on the coast and over 600 million people live within 40 feet of the ocean, this will have profound impact on human life. Sea level rise is already impacting a range of places, from Miami, Florida to whole island nations in the Pacific. (Before the Flood, the Leonardo DiCaprio film, explores this issue.)

Even a relatively small amount of sea level rise will have profound implications for humanity. Let's consider what will happen when the oceans rise by just a few feet. Even conservative estimates are that this will happen in the next few decades. Some estimates suggest that we will have five times this rise during the century.

Forty percent of land in Bangladesh will likely be lost with two feet of sea-level rise. Two feet of sea level rise will flood the entire coast of Florida. Roughly 75% of Florida's population lives in coastal counties. Miami is already regularly flooding during fair weather due to sea level rise.

Who will be most impacted by this?

Poorer people and poorer countries will suffer from climate change more than the wealthy. The great irony is that wealthier countries and individuals are contributing to climate change far more by emitting far more greenhouse gases.

An average American is responsible for 16.4 metric tons of CO<sub>2</sub> or equivalent gases being emitted per year. The average person in Sub-Saharan Africa emits 0.8 tons - less than one twentieth the amount.

While population is certainly an issue with respect to climate change, it can be misleading.

Africa is composed of over 50 countries. Together they have a population that is nearly four times the US. However, since the average African has greenhouse emissions that are 1/20th the average American's, The US. is contributing to climate change five times more than Africa. Even if Africa's population doubled, with everything else being equal, the US. would still be emitting more than twice as much as the entire continent of Africa.

When Americans suggest that global population is the root problem of climate change and look to places like Africa or India (where per capita CO<sub>2</sub> emissions are less 1/10th of the US.) as examples, it is not only misguided and simply wrong, it can reveal an underlying racism.

Greenhouse gas emissions should always be thought of as a ratio of emissions to population. If we were to compare Africa to the US. using this approach, with lower being better and Africa as the benchmark at 1.0, the US. would currently be at around 5.0 even though Africa's population is roughly four times that of the US.

In other words, even though Africa's population is around four greater than the US, the US. is contributing five times more to global climate change than the entire continent of Africa.

We refer to the social inequity of climate change as "environmental justice" or more recently as "climate justice."

"Environmental justice" can refer to any sort of environmental issue, such a point-source pollution. These can be local (such as the water crisis in Flint, Michigan), regional, or global.

"Climate justice" focuses on climate change in particular, which is a global issue.

In both cases, issues of environmental and social justice are often deeply intertwined (which The True Cost documentary makes clear).

