Eagle Audubon Society (EAS)

A Primer on Climate Change and Sustainability

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Part One: Climate Change

PURPOSE

This primer is to give members of Eagle Audubon Society who are not scientists information about climate change and the related topic of sustainability. Climate change is certainly in the news, as drought, wildfires and flooding are increasingly connected to climate change. Some members may be familiar with this material, but others may find information that is new to them. Part One focuses on climate change. Part Two revisits the topic of sustainability, which is one way of framing the ideas about how something could be done about climate change. Part Two also explores the concept of Earth consciousness—being aware of how humanity is connected to the Earth and other living beings, and how we can all learn to survive together.

For a shorter read, both parts begin with a summary of the information that follows.

SUMMARY

- Scientists have for the past several decades reported on the increased warming of Earth. While the term, global warming is often used, scientists prefer the term, climate change.
- *"Climate change refers to long-term shifts in temperatures and weather patterns. Since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas."* (United Nations Climate Change, 2020)
- After the sun's radiation enters the atmosphere and warms up the Earth, carbon dioxide, methane, nitrous oxide gases, and particulate matter such as dust prevent some of the heat from escaping back into space. This is like the way the glass panes of a greenhouse can trap heat.
- The annual mean global near-surface temperature for each year between 2022 and 2026 is predicted to be between 1.1 °C and 1.7 °C higher than preindustrial levels (the average over the years 1850-1900).
- Now, scientists predict that in 30 years there will be a heat belt in the middle of America in which 107 million people will experience heat index days of 125 degrees. (FirstStreet, 2022)
- There's more Carbon Dioxide (CO_2) in our atmosphere than at any time in human history.
- *"The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity."* (United Nations Climate Change, 2020
- *Because the Earth is a system, where everything is connected, changes in one area can influence changes in all others."* (United Nations Climate Change, 2020) This can include areas subject to colder temperatures than in the past.

- *"Ecosystems are resilient and adaptive, but the climate is changing at a rate that makes it difficult for plant and animal species to keep up. Many species of birds and other animals face extinction."* (Audubon, 2020)
- The steps needed to limit climate change and hopefully reverse its course are to become conscious of what is a healthy relationship of humans, the earth and other living beings, switch from fossil fuels to renewable energy, sequester carbon in plants and soil, and switch to regenerative agriculture.

INTRODUCTION

When I was a boy in south central Michigan, I helped my dad in the garden. We started tomatoes indoors and we waited to set them out and plant other seeds until after Memorial Day. He considered that a safe frost-free date. We expected the growing season to end with the first frosts around Labor Day. Now 50 years later the growing season in Michigan is several weeks, if not months longer on both ends. In the community garden in Florida where I have a plot, other gardeners say that the danger of winter frost, a problem ten years ago, is almost gone. Citrus is now being grown as far north as Georgia.

Those would be nice changes if they did not come with some tragic down sides. These include new and greater numbers of insect pests and diseases, extended periods of drought, more severe storms and flooding, and the health risks including more deaths associated with extreme high temperatures. Downsides also include the likely extinction of hundreds of species as the ecosystems they are adapted to change dramatically. All species play a role in the web of life that makes it possible for humans to inhabit Earth.

Scientists have for the past several decades reported on the increased warming of Earth. More recently, news services and elected and appointed officials have also been discussing it. While the term, global warming is often used, scientists prefer the term, climate change.

"Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas." (United Nations Climate Change, 2020)

Now, scientists predict that in 30 years there will be a heat belt in the middle of America in which 107 million people will experience heat index days of 125 degrees. (FirstStreet, 2022) Maximum heat indexes in the Tampa Bay region of Florida in the summer of 2022 have been about 108. The heat index is an expression of the effect of humidity and temperature on our bodies.

CLIMATE CHANGE BASICS

How warming takes place

After the sun's radiation enters the atmosphere and warms up the Earth, carbon dioxide, methane, nitrous oxide gases, and particulate matter such as dust prevent some of the heat from escaping back into space. This is like the way the glass panes of a greenhouse can trap heat. Without this "greenhouse effect," the planet would be too cold to support life as we know it. (Rainforest Alliance, 2021)

Warming of the Earth was predicted in the late 1800s. The greenhouse gas effect of carbon dioxide was identified in the 1850s. Few people payed attention. The industrial revolution made life for many more rewarding. How could one even tell the Earth was warming, and wasn't that a good thing?

"Examples of greenhouse gas emissions that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example. Clearing land and forests can also release carbon dioxide. [carbon is naturally stored in trees, tree roots, and micro-organisms in the soil.] *Landfills for garbage are a major source of methane emissions. Energy, industry, transport, buildings, agriculture and* [urban] *land use are among the main emitters.*

Greenhouse gas concentrations are at their highest levels in 2 million years. And emissions continue to rise. As a result, the Earth is now about 1.1°C warmer than it was in the late 1800s. The last decade (2011-2020) was the warmest on record." (United Nations Climate Change, 2020)

The annual mean global near-surface temperature for each year between 2022 and 2026 is predicted to be between 1.1 °C and 1.7 °C higher than preindustrial levels (the average over the years 1850-1900).

There's more Carbon Dioxide (CO_2) in our atmosphere than at any time in human history. Sensors at the Mauna Loa observatory in Hawaii, which has been tracking CO_2 concentrations in the atmosphere since the late 1950s, detected CO_2 values of more than 417 parts per million in February and March 2021.

In comparison to the time between 1750 and 1800, pre-industrial levels of CO_2 in the atmosphere were 278 ppm, implying that humans are halfway to doubling the quantity of CO_2 in the atmosphere. Activists have a target of 350 ppm. This will require a major reduction in the amount of CO_2 in the atmosphere by sequestering it in forests and underground.

The consequences of climate warming

"The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity." (United Nations Climate Change, 2020)

Sea level rise is a serious consequence of climate change, especially for coastal communities such as those in Florida. While melting polar and Greenland ice seem to get the most press, there is another factor already raising sea levels—higher water temperatures in the oceans. As water warms, it expands. Generally, expanding water has nowhere to go except up, and onto low lying coastal lands. Miami is already experiencing flooding of streets and yards during high tides as the ocean around southern Florida expands as much as 10 inches in height due to hotter temperatures.

The US military became concerned with the amount of gasses and particulate matter being put into the atmosphere a long time ago as it interfered with missile guidance systems. They remain concerned about climate change today. The Navy has 30 bases at sea level. Soon they will be stretched to patrol and help keep the peace as Arctic ice continues to melt and shipping lanes and resource extraction starts in the Arctic.

Higher temperatures wreak havoc on air quality, reduce crop yields, accelerate the spread of infectious illnesses, and jeopardize freshwater reserves. Natural disasters also get more intense as the planet warms.

According to some experts, we are during the planet's sixth mass extinction, which is primarily caused by human activities. Extinction is a natural occurrence, claiming roughly five species a day, but it is estimated that hundreds of plant and animal species now face extinction daily. That is approximately 1,000 times the natural rate; by the middle of the century, 30 to 50% of all species on the planet will

have vanished. As indicated earlier, humanity depends on the interaction of other living things with the Earth—the web of life.

Arctic sea ice is rapidly diminishing. We have lost roughly 28 trillion tons of ice since the mid-1990s, with a current melt rate of 1.2 trillion tons per year. To put it in perspective, the total weight of all human-made objects is 1.1 trillion tons.

Climate change impacts human life. This may seem obvious, but with so much focus on the affects climate change has on habitats and the vast array of species that inhabit them, it can be easy to forget the immediate impact on human life it has too. According to a 2018 study published in *The Lancet*, rising temperatures, along with an increase in the number of people living in cities and an ageing population, have resulted in a rise in heat-related mortality. (National World, 2022)

We continue to draw on renewable resources (forests, fisheries, etc.) faster than they can replenish as well as we reduce the area in which renewable resources such as forests, wetlands, and in some places, farms exist. Aggregate natural resource consumption has increased on a per capita basis (Princen 2005).

Despite that the Paris Agreement has been in existence for years, none of the world's major economies is on track to limit global warming to 1.5 degrees Celsius above pre-industrial levels.

The countries that contribute the most to global emissions have the best chance of preventing further climate change, but few leaders are doing much to address the problem.

Climate weirding

"Many people think climate change mainly means warmer temperatures. But temperature rise is only the beginning of the story. Because the Earth is a system, where everything is connected, changes in one area can influence changes in all others." (United Nations Climate Change, 2020)

A warming arctic destabilizes the atmospheric jet stream. More extreme fluctuations of the jet stream can lead to it dipping far south in the winter, bringing frigid air into southern parts of North America that rarely experienced them in the past. It is commonly but inaccurately called a polar vortex. (Kim, B.-M. et al, 2014), (NOAA, 2021) Such hard cold snaps following warm periods can wreak havoc on agricultural crops.

Climate change affects birds and other living beings

"Ecosystems are resilient and adaptive, but the climate is changing at a rate that makes it difficult for plant and animal species to keep up. Many species of birds and other animals are being forced out of their habitat ranges and, in the long-term, face extinction." (Audubon, 2020)

Climate action

Many groups are dedicated to stopping climate change, and if possible, reverse its predicted consequences. The basic action they all aim for is to limit greenhouse gas emissions and sequester, or luck up, carbon away from Earth's atmosphere.

Audubon Florida has a thoughtful and thorough Climate Action Agenda, which can be found at: https://fl.audubon.org/sites/default/files/conservation_action_agenda_22.pdf.

Steps needed to reduce greenhouse gas emissions and CO2 in the atmosphere

The following are steps that society can take to reduce the amount of carbon dioxide and other greenhouse gasses that are emitted into the atmosphere, and one step to recover some of the emitted CO2 and lock it up on Earth.

- Become Responsible Citizens of Earth

According to the Global Footprint Network, calculations show that the planet has available 1.7 hectares of biologically productive land per person to supply resources and absorb wastes—yet the average person on Earth already uses 2.8 hectares worth. These "ecological footprints" range from the 8.1 hectares claimed by the average American to the 0.8 hectares used by the average Mozambican. (Global Footprint Network. 2014) We continue to pollute the waters of the Earth. We use increased energy efficiency as an excuse to do more that requires energy, resulting in an overall increase in the use of energy.

We could if we chose, act in the best interests of ourselves and other living beings. Is it a stretch to agree that we have not been the best citizens when it comes to protecting the only home we have, Earth? We are spending a lot of resources to eventually colonize the moon and other planets, when we have not done a very good job of colonizing this one. What values about our home will we spread to other places? Will the Moon and Mars become trash dumps? There are no atmospheres, but will we create blankets of pollution?

Earth citizens, armed with facts and Earth-friendly values may be able to transcend status, ego, peer pressure, fads, and advertising to make decisions that help Earth heal. There are many ways to learn about how the Earth works: schools, internet, environmental nonprofit programs and participation. One of the best is through experiential learning—getting out of the house and immersing ourselves in our natural and built environment.

We cannot educate. We can only provide educational opportunities. Education only happens when a learner engages through experiences and investigation of information.

"It is incumbent upon us to take special pains…that all the people, or as many of them as possible, shall have contact with the Earth, and that the Earth's righteousness, shall be abundantly taught." Liberty Hyde Bailey (original 1915)

Become Earth conscious. There is more about learning to be good Earth citizens in Part Two: Sustainability and Earth Consciousness

- Change from Fossil Fuels to Renewable Energy. Now.

When the energy Earth gets from the sun in one hour equals all the energy used by the people of Earth in one year, it seems foolish to waste it. It is especially foolish when fossil fuels also pollute our air and water, cause lung diseases, and contribute to climate change.

It has only been since the discovery and large-scale extraction of fossil fuel energy that has enabled the expansion of an industrial society. According to DeYoung (2014) this was a one-time gift and has allowed humanity to extract fossil fuels and other resources with the mistaken view that they are unlimited resources on a finite planet.

We need to switch the vast subsidies the fossil fuel industry receives to promoting renewable energy development. Unfortunately, we may also need to bail out the fossil fuel industry. Fossil fuel industry investors and stockholder's own infrastructure plus coal, oil and gas futures that may be equivalent to

several thousand years of production. It will be an economic disaster if investors cannot realize a return on those investments. Yet it will be a greater disaster if they continue to extract coal, oil and gas.

- Manage Agriculture and the Food Stream to Reduce Greenhouse Gas Emissions

We need to change to regenerative agriculture from traditional crop and animal feed lot systems. Scientists are working on developing economically viable perennial grain crops. What is mostly farmed now are annual crops. Perennial grasses and grains form deep roots, while annual varieties form shallow roots. The benefit of deep-rooted plants is that they require less water, which requires energy to pump, and store more carbon underground. They also require fewer passes by gas guzzling farm equipment. When diverse crops are planted, there can be less need for pesticides.

Food waste causes more greenhouse gas emissions than the aviation industry. *"One of the easiest ways to cut down on food waste is simply to buy what you need and eat what you buy,"* says Jamie Crummie, co-founder of surplus food app Too Good to Go. *"The best way to do this is to carry out a weekly fridge and cupboard audit to see what needs eating up, and then make a shopping list before you go out."*

Many climate activists also advocate a plant-forward or plant-based diet as animal agriculture results in significant carbon and methane emissions.

- Plant Trees in Every Possible Location

According to Cabonfund.org, deforestation accounts for 11% of climate change. Tree harvesting on the scale it is occurring in parts of the world releases vast amounts of carbon as the trees are burned to make way for agriculture or development, and carbon stored in the soil is also released.

There are several programs devoted to planting trees in vast numbers. The National Forest Foundation (nationalforests.org) has a goal of planting 50 million trees by 2025. The purpose is to draw CO2 out of the atmosphere and lock it up in the wood and root systems of trees for a very long time. While it might take hundreds of trillions of trees to draw the bulk of excess carbon from the atmosphere, why not try? Forests are also great habitat for many bird species and other wildlife.

We have large areas of landscape that have no urgent purpose. These include interstate highway rights of way, abandoned golf courses, subdivision green spaces, school, and government campuses, and other cleared, but unused land. I once drove a Finnish professional forester from New York City to Michigan and he bemoaned the extent of public land that was not in forest. In his country every possible square meter was planted with trees. They would one day be harvested, but in the meantime provided ecological services. One would think businesses, homeowners and governments would like to cut back on expensive mowing. Unfortunately, many homeowners find five to ten acres of mown lawn a status symbol. And as one homeowner indicated to me, she was afraid of having nature (forest) close to her house.

In addition to trees, perennial grasslands are also great at storing carbon, and may be better suited to certain ecosystems.

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