Proceedings of the 3rd International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/20/20230782

The impact of global warming on polar marine life

Yiyao Li

Comford Royal School, Beijing, 102218, China

15050240139@xs.hnit.edu.cn

Abstract. The global region is currently facing enormous environmental issues of global warming, which is affecting the entire Earth's ecosystem, especially the natural environment of the oceans. Global warming is a natural phenomenon caused by energy imbalances caused by the cumulative greenhouse effect absorbed and released by the terrestrial air system. The ongoing energy buildup in the terrestrial air system has led to rising temperatures and global warming. Natural disasters and biological chain fracturing are just two examples of the dangers that climate change poses to various facets of humanity. The primary cause of this phenomena is one of the key causes of global farming. In addition, it poses a major threat to the equilibrium of natural ecosystems because of the astounding amount of carbon dioxide emissions produced annually, which directly contributes to an increase in atmospheric carbon dioxide levels. Climate change on the surface of the Earth is a direct outcome of this "greenhouse effect." Environmental pollution, which is getting worse every day, has grown to be a significant global issue and is one of the main causes of global warming. Today, studies on global climate change have amply demonstrated that the Earth's surface temperature has been increasing since the end of the last century. At the same time, this phenomenon has had a significant impact and harm on human survival.

Keywords: global warming, sea level, biodiversity, polar environment, oceans.

1. Introduction

There are many aspects to the impact and harm of global warming. Global warming will melt glaciers, leading to conflicts and wars around the world regarding water scarcity. Today, due to global warming, ice and snow on icebergs are building up faster than they are melting, and some icebergs have even stopped growing altogether, cutting off the supply of local drinking water. It affects the lives of coastal residents and threatens their lives. Low-lying island nations like the Maldives and Seychelles may vanish from the face of the earth if the polar ice sheet melts, along with many large coastal towns. Economically developed and heavily inhabited coastal areas will also be affected. Our ecological environment will deteriorate, and it will have an impact on human health. Extremely high temperatures will affect people's health more frequently in the coming century, as evidenced mostly by an increase in incidence rates and mortality. The bottom food will disappear, killing many creatures that feed on marine life. Global warming leads to ocean death, the bottom of the ocean food chain, and a vicious cycle of ocean pollution. Rising temperatures will also rouse numerous invertebrates from their dormancy, preventing them from hunting and leading to their mass extinction. Early in the morning, insects will consume a lot of crops and trees. This article mainly studies the impact of this phenomenon on marine and polar ecosystems [1-3]. The ocean has long been artificially created,

DOI: 10.54254/2753-8818/20/20230782

especially in polar regions. The ocean is the largest carbon sink on Earth, absorbing excess heat and energy from the Earth's system and releasing it through greenhouse gas emissions. Today, the ocean has absorbed the heat generated by the increase in emissions. Because too much heat and energy make the ocean warm, temperature changes will lead to ice and snow melting, sea level rise and ocean acidification and other impacts. It has been confirmed that atmospheric pollutants, especially light absorbing black carbon aerosols, can reduce the surface albedo of ice and snow after the sedimentation of glaciers and snow, and promote the melting of cryosphere. Meanwhile, as the low-temperature layer melts, the heavy metals and persistent organic pollutants stored in the low-temperature layer will be released in a concentrated manner, which may have potential impacts on the regional ecological environment. Population growth, air pollution, land degradation, and hazardous waste contamination are some of the drivers of global warming. One of the key causes of global warming is population growth. When people burn fossil fuels like coal and oil, or clear forests and burn them, they produce a lot of carbon dioxide, which raises Earth's temperature and is known as the greenhouse effect. When the greenhouse effect accumulates, the terrestrial air system absorbs and releases energy, and as energy builds up, it causes a rise in temperature and global warming [4]. The 21st century human civilisation is confronting a significant challenge in the form of global climate change. The primary aspect of climate change is global warming, which is discussed along with its effects on natural disasters, water supplies, agricultural production, biological species, diseases, and changes in sea level. For this important climate phenomenon, author consulted the China Science Exchange and Achievement Transformation Center of the China Natural Science Foundation, the Journal of Environmental Protection and Circular Economy, the China Academic Journal Electronic Publishing House, the United Nations Journal, the progress of atmospheric science, marine science, the National Natural Science Foundation, the progress of earth science, the United Nations Climate Action, and the progress of climate change research. The main objective is to understand the causes of global warming and its impact on the ecological environment of polar and marine regions, as well as its long-term adverse effects on human survival and development. This article also points out the significant impact of these phenomena on the living environment of organisms, as well as the need to adjust mitigation measures and living conditions.

2. Impact of global warming on the ocean

2.1. Sea level rise

In recent years, the ice reduction in polar regions of the world has accelerated. According to the most recent statistics from the World Meteorological Organization, the average sea level rose at an average annual pace of 4.5 millimeters between 2013 and 2021, reaching a record high in 2021. The sea ice with high albedo has become an open water area, enabling the ocean to absorb more heat during the summer and release it into the atmosphere during the fall and winter, increasing the temperature near the surface. A higher temperature will in turn lead to a positive albedo feedback of sea ice, which may amplify the signal of Arctic warming. At the same time, record breaking news was observed in the Antarctic region. The rise in sea levels and stronger tropical cyclones are exacerbating extreme weather occurrences like catastrophic storm surges and coastal catastrophes like erosion and landslides are currently anticipated to happen at least once a year in many locations. This has happened in every century of history. Since 2014, the coverage of Antarctic sea ice has been shrinking. The more remote polar regions of Antarctica are more than three times the global average. Research shows that this warming period is mainly driven by natural tropical climate changes, and may be aggravated with the increase of greenhouse gases [2, 4].

2.2. Heat waves

The frequency of ocean heat waves has doubled, and they are longer, stronger, and more widespread. The Intergovernmental Panel on Climate Change stated that human influence has been the main driving force behind the increase in ocean heat since the 1970s. When ocean temperatures rise for a

DOI: 10.54254/2753-8818/20/20230782

long time, disrupting the symbiotic relationship between corals and zooxanthellates, corals will undergo bleaching. Then the coral will expel insects, yellow algae, lose color (bleach), and die. Some corals have regained their health, but their immune system has been damaged, and in most cases they will die. Most of the heat waves occurred between 2006 and 2015, causing widespread coral bleaching and the deterioration of coral reefs. Nearly 60% of the ocean surface of the world will have had at least one heat wave by 2021. The United Nations Environment Programme says that if the sea continues to warm, all coral reefs in the world will experience bleaching.

2.3. Loss of marine biodiversity

The rise in temperature increases the risk of irreversible damage to marine ecosystems. A wide range of changes have been observed today, including the destruction of coral reefs and mangroves that support marine life, as well as the migration of species to high latitude and altitude areas with lower water temperatures. Researchers estimate that in the ocean, there are up to a million different species. A substantial number of species may migrate as a result of rising ocean temperatures, which might result in a decline in global biodiversity, a rise in species in colder regions near the poles, and a sharp decline in species in warm waters. The fisheries and aquaculture industries around the world may be significantly impacted by this change. According to the Food and Agricultural Organization of the United Nations, fish currently makes up 20% of the 3 billion sources of animal protein. Changes in local fish stocks may have a considerable influence on food security in light of population expansion if fisheries management is insufficient and fish exports rise, especially in underdeveloped coastal nations where climate change also threatens two types of marine oxygen supply, with many countries relying on fishing. First off, when the ocean heats, less oxygen will be present because warm water cannot contain as much of it as cold water. Secondly, the density of warmer water is lower, it makes it harder for water that is near the surface and is rich in oxygen to sink and circulate. Hence, there is a considerable risk associated with oxygen consumption. because oxygen dependent fish grow slower, smaller, and reproduce less. Larger oxygenated fish, sharks, tuna, swordfish and other fish are forced to float in surface water that has more oxygen, just like the majority of their prey, which increases competition for food. It has been proven that organisms living on the seabed also need to search for shallow water areas. This chain effect makes overfishing more likely to occur, because fishing will be simpler and more marine life will live in accessible locations. The amount of ocean warming is unacceptable. If the ocean is our best friend to date, it is likely to begin collecting our debts in the foreseeable future: since 1900, the waste we have generated and stored in the ocean is most likely to return to the atmosphere [5-9].

2.4. Impact of climate warming on sea ice and algae

On Earth, sea ice is a crucial ecological habitat. The Arctic and Antarctic have the largest sea ice coverage, accounting for 4.5% and 5% of the global ocean area, respectively. Low temperature, no light, poor light, and seasonal dynamics define the sea ice environment. Environmental elements like light, temperature, and salinity have a big impact on the eukaryotic phytoplankton that live in sea ice habitats during the seasonal variations in the creation and melting of sea ice. Various microalgae can adapt to these alterations and form different sea ice communities, which are called ice algae. Ice algae account for about 2% to 24% of the primary productivity of the Arctic and Antarctic marine ecosystems, and are an important food source for Antarctic krill and Arctic cod. Ice algae that animals do not eat will be remineralized or settle on the seabed, forming a biological carbon pump. Ice algae play an important role in the biogeochemistry cycle of the polar ecosystem and can survive in the biogeochemistry cycle of the polar ecosystem. Their capacity to adapt to the harsh environment of sea ice is intimately correlated with the distinctive physiological traits of ice algae, thus affecting the composition of sea ice biological community, the composition of polar ecology and the biogeochemistry cycle. The changes in sea ice structure will directly affect the available light, nutrients, and habitat space of ice algae, and have a chain reaction on the entire polar marine ecosystem [6-7, 10-11].

DOI: 10.54254/2753-8818/20/20230782

2.5. Impact of climate warming on polar bears

At the end of 2017, a video about polar bears went viral in the media. In the photo, a thin polar bear drags the tired, green North Pole, without snow. This video seems to show that climate change in the Arctic is killing polar bears. People cut down forests, burn fossil fuels, etc., and produce a large amount of greenhouse gases with high solar radiation transmittance. However, the absorption of longwave radiation emitted by the Earth is very high, the greenhouse effect, which is the process that causes the Earth's temperature to rise. With the accumulation of greenhouse effects, they will ultimately lead to global warming. Global warming has many harmful effects, most notably the melting of glaciers [12-14]. Usually, polar bears spend most of their time on ice, while some polar bears rarely live on land from birth. Global warming is affecting the lifestyle of polar bears. In the past, some polar bears lived on the edge of the Arctic Circle, close to the coastline, and were forced to land for several months due to the melting due to the rising temperature in summer. For polar bears, their main prey is enclosed. But global warming has reduced the ice on which polar bears rely, making it harder for seals to capture, forcing them to turn their attention to terrestrial mammals. Polar bears hunt reindeer more frequently. As the ice recedes, brown bears begin to live on land in search of food, and conflicts often trigger battles and kill the bears. On the other hand, there is no reproductive isolation between polar bears. They can mate freely. Some polar bears, such as "grizzly bears", are their offspring.

In terms of food supply, whale carcasses are often found in areas such as the Beaufort Coast of Alaska. For polar bears and brown bears, this is the easiest food to obtain, and their bodies will fight until death. Facts have proven that brown bears moving north are no smaller than polar bears, and the battle itself is unequal. Brown bears have a wide variety of subspecies. Some larger subspecies, such as Alaska brown bear, are roughly equal to or even larger than polar bears. In addition, in brown bear species, the mobility of males is significantly greater than that of females, so the first batch of bears to forage in the north were mostly adult males. The closer you are to the North Pole, the less vegetation there is, and the more foraging bears need to increase their share, which means they are better hunters and fighters. On the other hand, most polar bears trapped on land due to global warming are females with young. This issue further led to a decrease in the number of polar bears [14].

Arctic ice sheets can be divided into two categories: island ice sheets that cover land and marine ice sheets that cover the Arctic Ocean. Long term immersion in the heat rich Arctic ice sheet melts faster than the Greenland ice sheet that appears on land. The ice sheet's length has shifted from coast to coast in less than 30 years. Between sea ice and the coast, there existed a sizable gap as early as 2005. More than 70% of the ice in the Arctic Ocean's ice sheet is fresh, and its thickness has reduced from 3 meters to 1.5 meters. Peter Wadkins, a professor of marine physics at the University of Cambridge, explained why Arctic sea ice melts faster. The majority of the sunlight shining on ice is reflected since it is white. But now the ice is melting, and water is darker than ice, absorbing more sunlight. Water warming causes more ice to melt and is harder to recover from in the winter. The speed of this process will increase until the ice has entirely melted. The same applies to land ice sheets. Warmer temperatures in the Arctic Circle promote the growth of plants, causing the ice sheet to melt and the white land to be covered in dark vegetation. As a result, sunlight is more effectively absorbed by the surface than it is reflected by ice. which accelerates the rise in temperature. Looking at the story of the polar bear, it can ultimately be attributed to global warming. We may be surprised to find that humans are related to polar bears. Unless humans take more action to address climate change, polar bears will be nearing extinction by the end of this century.

2.6. List of solutions to issues caused by climate change

In the world, most glaciers have rapidly retreated in the past few decades. In order to prevent glacier melting, scientists have begun to study greenhouse gases themselves, in addition to controlling greenhouse gas emissions and mitigating the greenhouse effect. In August this year, a research team of the Chinese Academy of Sciences covered the Dagu Glacier on the eastern edge of the Qinghai Tibet Plateau with a 500 square meter quilt, trying to artificially reduce the loss of glaciers. Scientists use

DOI: 10.54254/2753-8818/20/20230782

insulating and reflective materials to cover the ice layer, reducing the impact of direct solar radiation on glaciers and reducing turbulent exchange in the near Earth atmosphere. The white coating also increases the albedo of the glacier surface, slowing down the melting speed." Nevertheless, the researchers explained that the insulation energy between this layer cuts off the heat exchange between the glacier and the outside world, keeping the glacier surface relatively cool under the insulation and reflective materials, slowing down the melting trend of the glacier [11]. In addition to being a way to assure greater food security, the sustainable management of marine resources is now more crucial than ever because of the strain being put on the ocean. Implementing measures is crucial for curbing overfishing and illegal fishing, as well as ensuring that many coastal fish dependent countries catch fish from industry. Stronger measures must be taken to prevent and reduce ocean inflows, including reducing the influx of ocean debris and nutrients. Finally, we need to expand research funding and broaden the scope of our knowledge in these sectors [8, 10].

3. Conclusion

Given the serious consequences of climate change, it is crucial to understand the true causes of climate change, so that timely measures and appropriate remedial measures can effectively curb the trend of climate change or enhance human response and resilience. However, there is a lot of debate about the reasons for climate change, and the prospects have not been resolved in the short term. It must be pointed out that uncontrolled development of fossil fuels and nuclear energy, large-scale afforestation, or artificial fixed methods to control greenhouse gases and dispersed Earth will become increasingly out of control. Sea level rise is one aspect, and at the same time, due to the rapid increase in seawater quality and crustal movement, the original equilibrium crust is disrupted, resulting in greater compression pressure on the crust. The catastrophic events associated with these movements, namely earthquakes and tsunamis, land and land plates, and possibly more volcanic eruptions, are extremely catastrophic, not just sea level rise that inundates cities. Of course, in the mid to late stages of climate warming, the catastrophic losses of these glaciers will gradually become clear. However, with the speed of glacier melting and global warming, if humanity does not change the current way of energy utilization and does not adopt large-scale afforestation, storage, and closure of excessive surface energy, climate warming will become faster and faster, and these negative impacts will mutually promote. The rate of glacier melting will be even more alarming, and sea level rise will be faster with earthquakes. Therefore, global warming will still be an environmental issue worth the world's attention. Only people from various regions can strengthen cooperation and achieve effective and reasonable political strategies as soon as possible. Although in the eyes of most people, the living environment in polar regions has moved away from our lives, protecting the polar environment and slowing down the melting rate of glaciers is a way of saving humanity itself. If major environmental organizations pay early attention to this issue, it may bring some hope to the entire planet.

References

[1] United Nations climate action. Causes and impacts of climate change. Retrieved on March 28th, 2023. Retrieved from: https://www.un.org/zh/climatechange/science/causes-effects-climate-change

[2] United Nations Climate Action. How does climate change affect the world's oceans? Retrieved on March 28th,2023. Retrieved from: https://www.un.org/zh/climatechange/science/climate-issues/ocean-impacts

[3] United Nations Chronicle. Climate change poses a threat to our oceans. Retrieved on March 28th, 2023. Retrieved from: https://www.un.org/zh/chronicle/article/20684

[4] National Natural Science Foundation of China,Center for Science Communication and Achiecement Transformation, from Xinhua net. Research confirms: Atmospheric pollutants accelerate glacier ablation. August 1, 2019. Retrieved on March 28th, 2023. Retrieved from: https://www.nsfc.gov.cn/csc/20340/20289/42141/index.html

[5] United Nations Chronicle. Marcia Kerry. The impact of climate change on coral reefs and the marine environment. Retrieved on March 28th, 2023.
[6] Li Fei, Gao Yongqi, Wan Xin, Li Qian, Guo Donglin, Wang Pengling, Li Huixin. Global Warming and the "Three Poles" Climate Change of the Earth. Journal of Atmospheric Science, Special Issue of "Polar Research". Volume 44, 2021. Page 1-41 of the 1st issue.
[7] Climate Change Research. Interpretation of IPCC SROCC on polar system changes and their impacts and adaptations. December 3rd, 2020. Retrieved on March 28th, 2023. Retrieved from: http://www.climatechange.cn/CN/10.12006/j.issn.1673-1719.2019.244
[8] Advances In Earth Science. Causes of Arctic Amplification: A Review. 2019.
[9] Liu Chenlin, Niu Yuanyuan, He Peiqing. Adaptation mechanism of polar ice algae to extreme sea ice habitats and its impact on climate change. Advances In Marine Science. April 2021, Vol. 39, No. 2, pp. 168-172.
[10] National Natural Science Foundation of China, Xinhua net, Science and Technology Daily. Antarctic polar warming is more than three times the global average. June 30, 2020. Retrieved on March 28th, 2023.
[11] National Natural Science Foundation of China,Center for Science Communication and Achiecement Transformation, Chen Yu, from Science and Technology Daily. October 30, 2020. Retrieved on March 28th, 2023.
[12] Ye Haiying, Zheng Guimei. Global warming threatens polar bears. Environmental Protection and Circular Economy. The second issue in 2009, page 58.
[13] Huang Lan. Will the polar bear disappear? Animals, nature exploration. Issue 12, 2018.
[14] Nan Bo Yi, Wu Sifan, from The Surging News. Polar bears are feared to become extinct by the end of this century, and experts call for more action to address climate change. July 22, 2020. Retrieved on March 28th, 2023.