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GLOBAL WARMING AND ITS IMPACT ON BIODIVERSITY: A PITHY

Rajeev Vats*, Sanjeev K. Gupta**

*School of Biological Sciences, College of Natural Sciences & Mathematics, The University of Dodoma, Dodoma (Tanzania)
**Head, Department of Zoology, University College, Kurukshetra University, Kurukshetra (Haryana)

ABSTRACT

There is minute disbelief among the scientific society that human induced greenhouse gas emission has contributed radically to the global warming. Most significant changes in the earth's temperature have been noticed since the advent of the industrial era in the late 1800s. Over the past 100 years, the earth's surface has warmed by approximately 0.6^0 C. Human activities such as the large scale burning of fossil fuels to operate big industries are releasing greenhouse gases like CO_2 into the atmosphere at an exceptional rate. Humans are currently releasing approximately more than 70 million tonnes of CO_2 per day into the atmosphere. Global warming, habitat loss, farming and over fishing are causing increased loss of biodiversity. Changing environmental factors are putting the planet in peril. Samuel Butler (1835–1902), in his Notebooks, published in 1912 said "All progress is based upon a universal innate desire on the part of every organism to live beyond its income." At the present time studies are beginning to show that the drive for progress is not only overspending humanity's environmental means, but that of all species on the planet. The present document draws from the major papers that have appeared in various journals on global warming over the past two decades, and gives an overview of anthropogenic climate change and its impact on a wide variety of life-forms.

KEYWORDS: Global warming, Greenhouse gas, Biodiversity, Climate change.

Introduction

There is minute disbelief today among the scientific society that anthropogenic or human induced greenhouse gas pollution has contributed radically to the global warming experienced since the beginning of the industrial era in the late 1800s (Houghton *et al.*, 2001; Santer *et al.*, 2003; Kannan & James, 2009). Over the past 100 years, the earth's surface has warmed by approximately 0.6^0C (Walther *et al.*, 2002, Kannan & James, 2009). Human activities such as the large scale burning of fossil fuels to operate industries are releasing greenhouse gases like CO_2 into the atmosphere at an unmatched rate. We currently release approximately more than 70

million tonnes of CO_2 per day into the atmosphere. Greenhouse gases are so named because they trap heat and hold back its radiation into the atmosphere; much like the glass panes on a greenhouse does, thus causing an increase in surface temperatures on earth. The already documented very dramatic and sudden rise in earth surface temperature through the1900s and beyond is shown graphically in the monographs by Cicerone (2006) and Linden (2006).

Scientists warn that if the current rate of greenhouse gas emissions continues, global air temperatures could increase between 1.5 to 4.5°C by the year 2100 (Houghton *et al.*, 2001). The direct and more physical consequences for human civilizations of such a temperature rise melting of glaciers and polar ice caps and the subsequent increase of sea levels and flooding of coastal areas, to increase in transmission of tropical diseases, to large scale disruptions in global climatic patterns resulting in both unusual droughts and flooding world-wide. Carbon dioxide levels (which have been clearly coupled with temperature increases) were under 300 ppm (parts per million by volume) for the past 600,000 years (Revkin 1992; Cicerone 2006; Gore 2006; Kannan & James, 2009). The levels touched 300 ppm for the first time in the 1900s and have been steadily increasing since then. Levels currently have passed at an all time high of 360 ppm, now are approaching 385 ppm, and are expected to reach 550 ppm by the year 2100 if current rates of emissions continue (Revkin 1992; Cicerone 2006; Gore 2006). The worst case scenario predicts that by year 2100 levels could reach as unimaginably high as 1,000 ppm. Clearly, we are headed for a CO_2 rich world with all its deleterious consequences, and are faced with the morally obligatory task of mitigating these levels by controlling greenhouse gas emissions.

Alteration in climate is not new, and species have traditionally responded to such change over evolutionary time scales. But the key question today is how organisms will react to the current rapid rate of anthropogenic climate change (Root *et al.*, 2003; Round & Gale 2008; Kannan & James, 2009). This manuscript focuses on the impact of such climate transformation on global biodiversity and it draws from the wide body of scientific facts that has accumulated over the past few years. It is projected for students and the lay public to enlighten them that global warming is a real and growing problem that threatens the life. The present study highlights some studies at the individual and population levels and has done some meta-analyses of data to recognize a worldwide logical fingerprint of global warming.

Evidence of extinctions due to global warming Worldwide

Harlequin frogs (*Atelopus sp.*) were the first charismatic conspicuous vertebrates to succumb to global warming. Sixty-seven percent of 110 endemic species have become extinct in just two decades (Blaustein & Dobson 2006; Pounds *et al.,* 2006). Several butterfly species have shown marked northward shifts in ranges in association with northward warming. Thirty-eight species in Europe and North America has been shift the range up to 200 km over a span of 27 years (Parmesan 2003; Walther *et al.,* 2002; Parmesan *et al.,* 1999).

Several species of birds arrived earlier than they did in pre-warming times. Spring first-time migratory arrivals advanced an average of 1.3 to 4.4 days per decade; and subsequent breeding activities too hastened by an average of 1.9 to 4.8 days per decade over a time frame of 30-60 years (Walther *et al.,* 2002). Over a span of 25 years, 20 species of birds were recorded to lay eggs significantly earlier than they did before. The average egg laying dates will be even earlier for 75% of avian species by the year 2080 (Crick *et al.,* 1997; Crick & Sparks 1999). The consequences of such early breeding can be varied. If not coordinated with prey abundance, such early breeding could result in decreased lifetime reproductive success and recruitment rates. Twelve species of U.K. birds have shifted their ranges by an average of 18.9 km over the past two decades, even after controlling for overall population expansions (Thomas & Lennon 1999). Early arrival in the spring of migratory birds has resulted in increased competition for optimal nest sites with early nesting resident species (Both & Visser 2001). Birds in Europe and the western Palearctic are laying eggs earlier (Both *et al.,* 2004; Sanz 2003).

Arrival dates of short-distance migratory birds in North America seem to have been affected disproportionately by global warming (Butler 2003). Dunn & Winkler (1999) reported that climate change has affected the breeding date of tree swallows throughout the continent. In Canada, warming trends have resulted in a northward expansion of the range of the red fox, and a subsequent retreat of the range of the Arctic fox (Hoffman & Parsons 1997; Walther *et al.,* 2002).

Reduction in sea ice area near the Antarctic Peninsula has affected krill recruitment rates. With Antarctic krill being a prime staple diet for numerous oceanic species (including whales) this reduction in krill numbers could have profound effects on the regional food web and subsequently on human economics (Loeb *et al.,* 1997). One of the most destructive effects in

association with global warming is evident in the coral reefs of the world's oceans (Glynn 1991; Hoegh-Guldberg 1999; Mumby *et al.*, 2001).

Global warming could directly affect human fishery industry. Variations in atmospheric air circulation over the Bering Sea impede the movement of juveniles away from adults of a commercially and ecologically vital species of fish, the Walleyed Pollock (*Theragra chalcogramma*) (Cushing 1995). This makes the juveniles increasingly vulnerable to cannibalism.

Solution and Conclusion

It is apparent that all regions of the planet earth in some ways are being adversely affected by the global warming. The average temperatures in tropical biomes are shown to increase nearly by 5 degrees Celsius from the mid 1960s to 2050. The culprits in this global heating scenario are the so-called greenhouse atmospheric gases that capture heat through the activities of people. Most of the curative measures concern mainly to the industrialized world, such as developing alternate sources of energy rather than depending heavily on fossil fuels, or manufacturing more petrol efficient automobiles, to name a couple of actions.

Professor E. O. Wilson said that "The loss of species is the folly our descendants are least likely to forgive us". So for the sake of posterity and for the very future of our planet's biodiversity, let us curb greenhouse gas emissions and mitigate the threat of global warming.

Red List of some Endangered Species due to Global Warming*

In a press release, published in Barcelona on October 6, 2008 by the International Union for Conservation of Nature (IUCN), on the publication of their 2008 "Red List of Threatened Species", Julia Marton-Lefèvre, IUCN Director General says "Within our lifetime hundreds of species could be lost as a result of our own actions, a frightening sign of what is happening to the ecosystems where they live." The list highlights a number of areas where species are threatened by a changing environment.

Environmental Threat to Mammals

- 188 mammals are in the highest threat category of Critically Endangered, with the Iberian Lynx down to a population of between 84 and 143, while the Chinese Pere David's Deer is now classed as extinct in the wild.
- The Polar Bear population is estimated to have fallen by 33% over the last 45 years. The Red List notes that "The increasing changes in the sea ice that affect access to prey will

have a negative effect on the bears. With less food, polar bears will fail to reproduce more often and give birth to smaller young that have higher mortality rates." It also goes on to list pollutants in the food chain, especially in Greenland, the Barents Sea and the Kara Sea as second only to loss of sea ice, as a major threat.

- Habitat loss, such as deforestation, intensive farming and change in land use affect nearly 40% of the world's mammals. This is most extreme in Central and South America, West, East and Central Africa, Madagascar, and in South and Southeast Asia.

Environmental Threats to Marine Species

According to a report based on the Red List entitled "Status of the World's Marine Species", by Beth A. Polidors *et al.*, published by the IUCN in 2008, "The oceans are home to a large percentage of Earth's biodiversity, occupying 70 percent of its surface". Highlights of the report are:

- 17% of shark and ray species are in the threatened category and 13% are considered near threatened and may reach the thresholds for a threatened category in the near future if current threats are not reduced.
- Groupers, found mostly in the tropics and sub tropics, are a very important source of food, but now 12% of the world's grouper species are threatened with extinction.
- Marine mammals include whales, dolphins, porpoises, seals and walruses. 25% of these marine species are now under threat.
- Almost one third (27%) of marine sea birds, including the Albatross and Puffin are threatened with extinction.
- The major threats to marine species are over fishing, loss of habitat due to coastal erosion or development, water pollution, loss of food and environmental changes due to global warming.

Amphibians and Climate Change

A report published in Volume 439 in *Nature*, in January 2006, entitled "Widespread Amphibian Extinctions from Epidemic Disease Driven by Global Warming", the authors, J. Allen Pound *et al.*,., show that thousands of species of amphibians have suffered dramatic declines and hundreds of species have disappeared. They conclude by stating "We establish that global climate change is already causing the extinction of species."

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