www.ijemr.net ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

Volume-5, Issue-4, August-2015

International Journal of Engineering and Management Research

Page Number: 162-167

Biodiversity and Species at Risk from Climate Change

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ABSTRACT

One of the biggest threats that biodiversity is facing today is change in climate and its impact on species survival. Conservation of biodiversity will help in building more resilient ecosystems and slow down this change giving ample time for species to adapt .Climate change has serious implications on the ability of species to adapt and survive in such anthropogenically altered environment. The only solution for this drastic problem is to maintain and conserve the resources and services provided by the ecosystem. Climate change is accelerated by human generated activities like increase in fossil fuel combustion, deforestation and land use changes etc. A number of species are on verge of extinction simply because we are overexploiting the natural resources, causing habitat destruction, pollution, global warming etc. and bringing environment to such a point where it is beyond the carrying capacity of environment to restore itself. Biodiversity is facing a big threat from changing climatic patterns like disturbance in hydrological cycle, rising temperature, changes in wind circulation and pressure regions, natural disasters, melting of glaciers and rising sea level.

Keywords*----* Biodiversity, Climate change, species, conservation.

I. INTRODUCTION

Biodiversity defines simply the variability that exists between living organisms (within species, between species and ecosystems) from all sources (terrestrial ecosystem or aquatic ecosystems). (UNCBD)

Biodiversity is facing severe threat from climate change but the resources and ecosystem services can reduce the impact of climate change. Climate change is projected to affect individual organisms, populations, distribution of species and composition and function of ecosystem both directly (e.g. through increases in temperature due to increase in concentration of greenhouse gases , changes in precipitation ,changes in sea level and storm surges) and indirectly (e.g. Through climate changing the intensity and frequency of disturbances such as wildfires). Species will be affected directly by climate change. The general effect of projected human induced climate change is that the habitats of many species will move poleward or upward from their current locations. Some of the species that are facing severe threat from climate change are Polar Bear, Arctic foxes , Staghorn corals , Salmon , Leatherback Turtles , Ringed Seals , Quiver Trees , Koalas , Beluga Whales , Clownfish , Emperor Penguins , Golden toad etc .Climate change adaptation activities can promote conservation and sustainable use of biodiversity and reduce the impact of changes in climate and climate extremes on biodiversity (Climate Change and biodiversity, IPCC Technical paper V)

II. GREENHOUSE GASES AND GLOBAL WARMING

Rise or increase in temperature of earth is due to deforestation, accelerated use of fossil fuels, and other industrial activities which lead to build up of green house gasses. More trapping of long wave infrared radiation by green house gasses like Carbon dioxide (CO_2), Chlorofluorocarbons (CFC's), Methane (CH_4), Nitrous oxide (N_2O), is causing warming of the earth surface.

Global warming is an increase in the Earth's temperature due to the use of fossil fuels , deforestation and other industrial processes leading to a build up of "Green house gases" like Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Chlorofluorocarbons (CFC's). The main cause of Global Warming is greenhouse gases. Although they are dozens of green house gases four of them are most important.

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These are as follows –

Gas	Pre-1750 tropospheric concentration	Recent tropospheric concentration	GWP (100-yr time horizon)	Atmospheric lifetime (years)	Increased radiative forcing[5] (W/m^2)
Concentrations in parts per million (ppm)					
CO_2	280	395.4	1	100-300	1.88
Concentrations in parts per billion (ppb)					
CH_4	722	1893/1762	28	12	0.49
N_2O	270	326/324	265	121	0.17
O_3	237	337	n.a.	hours-days	0.40
Concentrations in parts per trillion (ppt)					
CFC-11	0	236/234	4,660	45	0.061
CFC-12	0	527/527	10,200	100	0.169

Table-1: Green House Gasses & Their Contribution to Global Warming (Source: Carbon Dioxide Information Analysis Center, T.J. Blasing, 2014)

III. GLOBAL WARMING AND SEQUENCE OF EVENTS LEADING TO CLIMATE CHANGE

Rising levels of greenhouse gases are already changing the climate. According to Intergovernmental panel on Climate with the increase in deforestation, fossil fuel combustion there will be increase in greenhouse gases and global temperature will increase (increase is between 1.4 to 5.8 ◦C by the end of the 21st century,) .This will lead to glaciers melting (Antarctic ice, Arctic ice) and rise in sea levels (0.09 to 0.88 m). This may upset the hydrological cycle, results in floods and droughts, changes in agricultural productivity, famines, death of animals, livestock. This may lead to even phenomenon like El-Nino. The global change in temperature will not be uniform everywhere and will fluctuate in different regions. At higher latitudes places will be warmed up more during late autumn and winter than the places in tropics (may be only 50 to 100 % on an average). The increased warming at poles will cause reduction in the thermal gradient between the equator and high latitude regions decreasing the energy available to the heat engine that drives the global weather machine. This will cause disturbance in the global pattern of winds and ocean currents as well as timing and distributions of rain fall. Shifting of ocean currents may change the climate of Iceland and Britain and may result in cooling at a time when rest of the world warms. By a temperature increase of 1.5 to 4.5˚C the global hydrological cycle is expected to intensify by 5 to10 %. Disturbed rainfall will result in some areas becoming wetter and the other drier. Higher temperatures will result in more rainfall, more evapo-transpiration leading to annual water deficit in crop fields. Violent storms, loss of species, biodiversity loss etc.

IV. CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. Its focus is on sustainable use of biological resources and conservation of biological diversity especially the fair and equitable sharing of benefits arising from the use of genetic resources.

V. EFFECT OF CLIMATE CHANGE ON SPECIES

Climate change is affecting all aspects of biodiversity. The warmer regional temperatures, have affected migration of animals, timing of reproduction in animals and, the length of growing season in plants, species distributions and population sizes and the frequency of pest and disease outbreaks.

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ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

VI. SPECIES MORE AT RISK FROM CLIMATE CHANGE

There is growing evidence that climate change will become one of the major drivers of species extinctions in the 21st century. According to IPCC at the global level about 20% to 30% of species will be at increasingly high risk of extinction, as global mean temperatures will exceed 2 to 3°C above pre-industrial levels, possibly by 2100. Some species are much more vulnerable to climate change impacts than others due to their life history, and their ecological, behavioural, physiological and genetic traits. The risk of extinction increases markedly when species experience both high susceptibility to climate change and large climatic changes.

VII. METHODOLOGY

Extinction risks will accelerate with future global temperatures, threatening up to one in six species under current policies there is urgent need to adopt strategies that limit further climate change if we are to avoid an acceleration of global extinctions and (Mark C. Urban).

On the basis of biological characters that make species suspect to climate change species at risk from climate change are studied. IUCN has identified five groups of traits that are believed to be linked to increased susceptibility to climate change; these are as follows:-

S. No.	BIOLOGICAL CHARACTERS OF SPECIES	SUSCEPTIBLE TO CLIMATE CHANGE
1	Specialized habitat / microhabitat requirements	Yes
2	Dependence on interspecific interactions	
3	Narrow environmental tolerances	
4	Reliance on specific environmental triggers	
5	Poor ability to disperse to or colonize a new or more suitable range	

Table:-2 Biological Characters of Species making it Susceptible to climate change

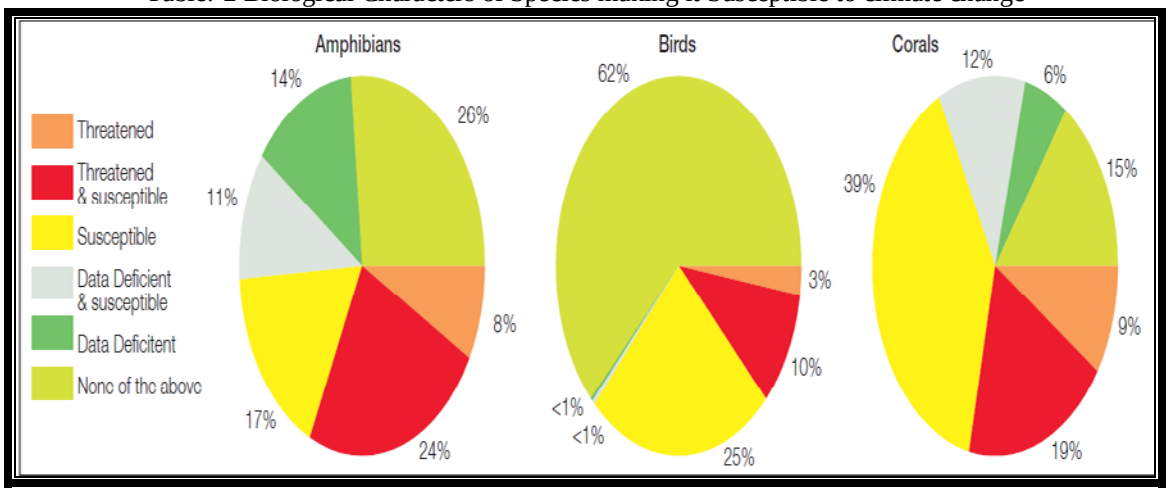

Fig.1:- The proportion of Birds' Amphibians and Warm water Reef –Building Corals assessed as combinations of threatened (According to the 2008 IUCN Red List)"Climate change –susceptible "and Data Deficient.

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ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

IUCN has collected information relating to these groups of traits for the world's birds (9,856 species), amphibians (6,222 species) and warm-water reef-building corals (799 species).Through IUCN's work it is known that 70-80% of birds, amphibians and corals that are already threatened are also "climate-change-susceptible**.**

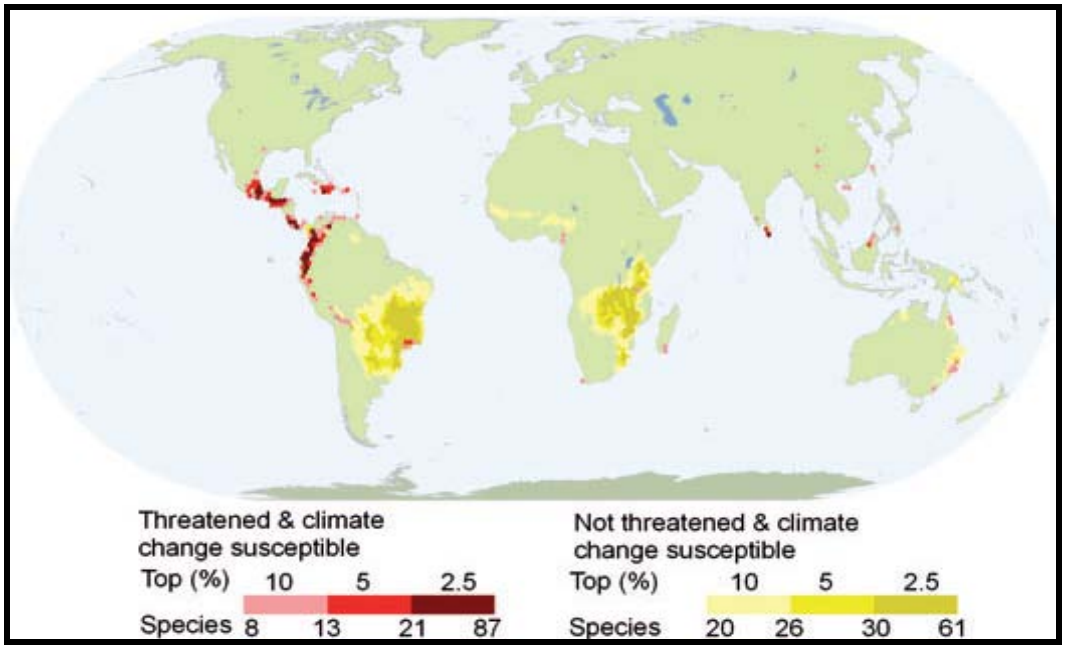

Fig.2:- Areas of highest concentration (top 10%, 5% and 2.5% globally) of amphibian species assessed as threatened and "climate- change-susceptible" (reds), and not threatened but "climate-change-susceptible" (yellows).(Source :IUCN)

POLAR BEAR AND CLIMATE CHANGE

The main concern about climate change effects on polar bears is habitat loss, changes to the prey species available and changes to marine ice habitat. The sea ice on which polar bear depends has undergone recent decline in area, thickness and duration of cover as a result of global warming. The most telling impacts of climate change on polar bears have been noted in western Hudson Bay, where declines in their reproduction, body condition, and survival have resulted in a 22 % reduction in subpopulation size between 1987 and 2004.

STAGHORN CORALS AND CLIMATE CHANGE

Climate change has a wide range of impacts on corals and the reefs they make, the most significant of which are bleaching (Great Barrier Reef in Australia) , Ocean acidification (affects the process of calcification impacts marine animals like corals and molluscs) and increased disease susceptibility. Globally, 20 percent of coral reefs are already damaged beyond recovery. Of the 704 species of corals that were assessed in the IUCN Red List Assessment (2008), 33 percent are listed as threatened.

LEATHERBACK TURTLES AND CLIMATE CHANGE

Leatherback Turtle (Dermochelys coriacea) nesting beaches are being washed away due to rising sea level, cyclones and storms (beach erosion and degradation), while rising sand temperatures during egg incubation disturbs sex ratio and lead to disproportionately lower numbers of males (gender is determined by embryonic temperature), changes in oceanic currents are likely to affect the abundance and distribution of jellyfish and other Leatherback prey species.

RINGED SEALS AND CLIMATE CHANGE

Many aspects of the Ringed Seal's life cycle are dependent upon their ice habitat (reproduction disruption and more and more pups may be separated prematurely from their mothers, resulting in high pup mortality due to melting of Arctic ice), and many of their activities are governed by the timing of the formation and break-up of ice sheets. Warmer ocean temperatures are likely to make conditions more favorable for Ringed Seal parasites and pathogens.

QUIVER TREES AND CLIMATE CHANGE

Quiver Trees are losing populations in the equator-ward parts of their distribution range due to drought stress. They draw attention to problems that all plants and slow-moving species face in keeping up with rapidly accelerating changing climate. By 2001, large die-offs of Quiver Trees were going on, generating concern amongst the natives of Namibia and South Africa. In contrast, populations on the pole-ward range areas and at the tops of high mountains were growing and reproducing.

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Species are known to respond to climatic warming by shifting their ranges closer to higher latitudes and higher altitudes, where environmental conditions are typically cool and there is sufficient moisture.

KOALAS AND CLIMATE CHANGE

Koalas are experiencing malnutrition as Eucalyptus leaves decline in nutrient richness and increase in tannin. Climate change is predicted to include an increase in drought frequency and high-fire danger (Bushfires) in many parts of Australia, due to decline in rainfall levels, increase in overall temperature and evaporation rates. Increased atmospheric CO_2 levels tend to result in faster plant growth "CO_2 fertilization' results in reduction of protein levels and increases tannin levels in plants' leaves.

ARCTIC FOXES AND CLIMATE CHANGE

Arctic Foxes face habitat loss (tundra habitat are expected to slowly be replaced by boreal forest), competition and predation from Red Foxes, along with changes in population cycles of their prey. Any declines of important prey species are likely to have significant impacts on Arctic Fox populations.

BELUGA WHALES AND CLIMATE CHANGE

Beluga Whales are losing their refuges from humans as Arctic sea ice melts, and also face new competitors (Humpback whales, seals), predators (Killer Whales), reduction in availability of prey species, more cases of ice entrapment and diseases.

EMPEROR PENGUINS AND CLIMATE CHANGE

Emperor Penguins are predicted to lose sea ice platforms for breeding and face changes in food availability (Reduction in number of Krill in the Southern Ocean effects Antarctic food chain). Early ice break-up in warm years has caused chicks to be swept into the ocean and drowned. Should global temperatures increase by 2°C; scientists estimate that colonies to the north of 70°S would probably become unviable. This means that 40 percent of the entire colonies, and almost 40 percent of the total breeding population of Emperor Penguins would be affected.

VIII. ACTIONS TAKEN FOR CONSERVATION OF BIODIVERSITY AND REDUCTION OF IMPACTS ON CLIMATE CHANGE

The resilience of ecosystems can be enhanced and the risk of damage to human and natural ecosystems reduced through the adoption of biodiversity-based adaptive and mitigative strategies. Mitigation is described as a human intervention to reduce greenhouse gas sources or increase carbon sequestration, and adaptation to climate change refers to adjustments in natural or human systems in response to climatic stimuli or their effects, which moderates harm or exploits favorable opportunities. Examples of activities that promote mitigation of or adaptation to climate change include: Maintaining and restoring native ecosystems, managing habitats for endangered species, Protecting and enhancing ecosystem services., establishing networks of marine ,terrestrial and freshwater protected areas that take into account projected changes in climate. Biodiversity is threatened by human-induced climate change but resources provided by biodiversity can reduce the impacts of climate change on people and production.

IX. CONCLUSION

Climate change is an important driving mechanism for altering the distribution of species and, so, the species composition of the habitats and ecosystems that characterize landscapes. The pivotal question in the debate on the ecological effects of climate change is whether species will be able to adapt fast enough to keep up with their changing environment. If we conserve our ecosystem and its resources and services then we could improve rate of adaptation of species to changing climate, and thus give greater chance and time for species to survive and thrive in new altered environment. Species can usually adapt if conditions change slowly. Worsening climate change effects are unavoidable because of the lag-effects of the greenhouse gasses that we've by now emitted. But it is still not too late. If our governments commit to strong and timely targets to reduce emissions, and stick to them, we can slow down the pace of climate change and give these and other species a chance to survive. Habitat loss and its degradation should be stopped and resilience of species to changing climate must be improved.

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