



Review Paper

## Potential Impact of Fluctuation in Climatic Activities on Migratory species: A Review and Recommendation

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### Abstract

*Knowledge of impacts of future climate change varies greatly between taxonomic groups where changes in range are widely documented in all taxa in various study, with distributions of most shifting pole wards. Climate change is long-term changes in weather patterns that characterize the changes in climate around the world. It is projected to have significant impacts on conditions affecting fauna, including temperature, precipitation and glacial run off that reduces production of agriculture which adversely affects faunal diversity directly. Animal migrations are important to the healthy function of many ecosystems. An impact of climate change on migratory species is a challenge, particularly with endangered species, which are subject to many other pressures. The emerging risks associated with climate change are the outcomes of physical processes that caused by human activities. Climate change has the potential to cause immense biodiversity loss, affecting both individual species and their ecosystems that support economic growth and human well-being. It is difficult to predict the overall result of climate changes on animal and plant kingdom. This realization should bring moral responsibilities, including responsibilities to reflect upon and change energy policies that inflict harm on the vulnerable sections of humanity in the present as also future generations.*

**Keywords:** Migration, Conservation, Birds, Fish, Climate Change.

### Introduction

Climate change is a global issue that proceeding at a rate at which there will be unavoidable impacts to humans, wildlife, and habitat. Decades of scientific research have shown that climate can change from both natural and anthropogenic causes. Although anthropogenic activities induced climate change, is one of the major factors that affect the Earth's ecosystems in the coming years and centuries<sup>1</sup>. Animal migrations are essential to the healthy function of many ecosystems by facilitating dispersal of plant species, cycling resources between locations, and allowing life to persist in some of the most extreme locations on earth<sup>2</sup>. Climate change is predicted to have many varied impacts on species around the world. Aidley<sup>3</sup> studied that migrations are recurrent movements of any species between their habitats that benefited seasonal productivity of habitat during the breeding season. Span of migrations is a range of movements from long, cross-continental movements to comparatively short movements of a few hundred meters.

It is impractical to monitor all species and all pathways of climate change that affect the great range and diversity of taxa. Climate change impact on wildlife through many physical and ecological processes could be monitor by key indicators called as bioindicators that comprise of certain parameters of

species/populations or group of species as proxies for wider assemblages, habitats and ecosystems.

The climate condition forces the animals to migrate. Migratory species travel very large distances, often between discrete sites. The species likely to be affected by climate change once in their life cycles, and there are negative, positive and neutral evidence of impacts on a wide range of birds, fish, bats, terrestrial mammals and insects<sup>4,5</sup>. While there are a large number of physical measures of climate change and there are few indicators of the biological consequences of climate change.

### Causes of Climate Change

The reason of climate change is only the alteration of area's climate during varying periods and this is very common when the atmosphere of earth absorb all amount of sun energy by any change happen in the earth or the planet. One more reason of climate change may be due to escape of some amount of earth's heat into the space for an indefinite period. Many natural processes such as volcano eruption or forest fire and human activities such as industrialization use of automobiles and many others are responsible for the production of a high amount of heat which increases earth's temperature and causes climate change in the planet. Green house gases have major contribution to it<sup>6</sup>.

**Table-1**  
**Summary of few migratory species including their distribution pattern and migration path**

Species	Effect	Season	Status	Environmental factor	Reference
Grey Heron	Survival	Winter	Migratory	Temperature	Besbeas <i>et al.</i> 2002
Grey Plover	Survival	Winter	Migratory	Temperature	Clark 2004
Sand Martin	Survival	Spring	Migratory	Rainfall	Szep 1995
Sedge Warbler	Survival	Winter	Migratory	Rainfall	Peach <i>et al.</i> 1991
Pied Flycatcher	Productivity	Breeding/summer	Migratory	Temperature	Jarvinen 1989 Eeva <i>et al.</i> 2002
Heron	Productivity	Winter	Resident	Temperature	Marchant and Higgins, 1993
Golden Plover	Productivity	Winter	Migratory	Temperature	Yalden and Pearce- Higgins 1997
Sand Martin	Productivity	Winter	Migratory	Rainfall	Szep 1995

**Birds:** The impact of long term changes in weather pattern on the population biology of birds has been a major field of study by ornithologists over the past few decades. The implications for birds on climate change is long-term shifts in average weather, have been affected animals and plants<sup>7-9</sup>. These effects include early breeding; changes in breeding performance (egg size, nesting success), shifting in time of migration, changes in population sizes and distributions and changes in selection differences between components of a population.

Birds are the important bioindicator group because birds are both popular and often have an iconic or totemic status throughout the world (for example, storks are known as ‘rain birds’ in Africa, Koel indicate the ripening of mango and upcoming monsoon around the world. Similarly Eagles have been used for centuries as heraldic symbols throughout Europe and North America). Siberian birds have come to Indian subcontinent during early winter to spring season due to favourable climate condition of India.

Anonymous<sup>10</sup> studied on 298 migratory birds and record various effects of climate change that affect them adversely and according to him higher storm frequency cause habitat destruction and direct mortality of birds while least affected by introduction of other species. Summary of few migratory species was studied by CMS that describe all the factors affecting the migration and the effect of climate change on few animals are given below in the Table-1 including their distribution pattern and migration path.

### Impact on Fish

Fish is a good source of food for men which affected their lives in various ways. In the world, millions of people suffering from malnutrition and hunger, and fishes are the richest source of

food where employment resources are limited due to water which provides a reason to survive over the nutritional deficiencies and difficulties of men. Fish serves as foods as well as it provide many by products which are an addition income to fishermen. All fishermen are unable to adopt change the fishery due to low financial status cause damage in their fish resources<sup>18</sup>.

Water is used for the cooling of power station which makes water quite hot that discharged to the river and streams and rises temperature of water body. As a result dissolved oxygen content reduces from water, affecting its fauna. Climate change is one more difficulty for the fish stocks because it causes major problems such as fishing mortality, loss of habitat, pollution, disturbance, and introduced species. This means that the impact of climate change must be evaluated in the context of other anthropogenic pressures, which often have greater and more immediate effects<sup>19</sup>.

Nuclear power stations are beneficial to human but their construction and operation of nuclear power stations can create barriers to migration of animals mainly in the aquatic environment. Station operations may block or restricted the path for migratory fauna in some rivers, streams and estuaries and creates only narrow zones. The construction and placement of Nuclear power station structures in the water body can partially or fully block the migration zone or path, as a result of heat and chemical discharge in to the water body. This make a strong water current in which actively swimming aquatic animals often avoid waters of adverse quality, but larval and immature forms are usually moved and dispersed by water currents. It is therefore important in site selection before nuclear power station construction that the routes and times of movement of the immature stages be considered in relation to potential effects.

Canals or areas where cooling waters are discharged may induce fish to remain in an unnaturally warmed and less oxygen habitat. The cessation of station operation during winter can be lethal to these fish because of an abrupt drop in water temperature. A detailed study of potential impact on each species population would be required for sites where placement of Nuclear Power Plant intake or discharged structures would markedly affect normal current patterns in migration paths of important species.

Aquaculture is badly affected by climate change and there is broad concern arise newly developed methods, technology and significant variation in fisheries production for its betterment. According to Brander<sup>20</sup> who reported that the distribution of fauna, species composition, seasonal variation and production in aquatic system economy is affected by climate change. Fish are of considerable food value and form an important part of the human diet in the world which is highly nutritious, provides all essential elements and vital nutrients which are absent in poor people's diets<sup>21</sup>. Fish is the cheapest animal protein source. Fish meal contains about 60% protein which is used for cattle food

and provides about 20% of protein intake as far as availability and affordability is concerned by the poorer human<sup>22</sup>. Fish oils are rich in polyunsaturated fatty acids (PUFAs) so it is appeared in the human diet as healthiest food<sup>23</sup>.

Oxygen is one of the pre-requisite for aquatic fauna which temperature dependent. Warmer water have low oxygen holding capacity which reduce water quality for survival of organisms such as invertebrates and fish which cannot tolerate oxygen stress<sup>24</sup>. Plankton production rate and diversity increase in the warmer water which affects the gross productivity of ecosystem by enhancing the food web. However, microbial activities and rate of decomposition of organic material increase in higher water temperatures resulted in less food availability in the ecosystem which also decrease production rate and increase mortality of animals. Higher temperature affects water quality; pollutants accumulate in the surface water led to increased levels of toxicants and other contaminants in fish. In some areas various local and migratory fish species have seen in last decade<sup>19</sup>.

**Table-2**  
**Summary of few migratory species studied in the Convention on the Conservation of Migratory Species of Wild Animals (CMS)**

Name of species	Common name	Distribution	Migratory region	Threats	Causes	Effect
<i>Physeter macrocephalus</i>	Sperm whale	Worldwide	Polar to tropical waters	Vulnerable	changes in prey abundance	Alter reproductive success
<i>Puffinus griseus</i>	Sooty shearwater	Europe	Trans-equatorial pelagic migrant; Passage migration	Not Threatened	Altered ocean circulatory system	Population reduction
<i>Chelonia mydas</i>	Green turtle	Circumglobal	Tropical to subtropical	Vulnerable	High temperature	Breeding, nestling, hatchling rate disturb
<i>Grus leucogeranus</i>	Siberian crane	Palearctic	Eastern Palearctic migrant	Critical	Loss of taiga/tundra vegetation changes and fluctuating hydrological regimes	Breeding adversely affected
<i>Gadus morhua</i>	Atlantic cod	North Atlantic	-	Vulnerable	Overfishing, Fluctuations in plankton	Growth and lifespan decrease
<i>Ficedula hypoleuca</i>	Pied flycatcher	Western Palearctic	Trans-Saharan migrant	Not Threatened	Phenotypic miscuing	Advancement in breeding schedules
<i>Eidolon helvum</i>	Straw coloured fruit bat	Centrak Africa, Arabian Peninsula	Long-range migrant within continental Africa	Least Concern	Increase temperature, reduced rainfall, increase desertification, low food availability	Distribution and loss of synchrony within breeding colonies

## Habitat destruction and collapsing of food web

Protective and breeding habitats of polar marine animals are adversely affected by melting of sea ice due to global warming. Reeves *et al.*<sup>24</sup> studied on bowhead whale and Laidre and Heide<sup>25</sup> studied on Narwhale, concerns over the requirement of Arctic sea ice protection which affected their habitat and breed. Intense warming projected Arctic zone having ice free summers expected near 2025-2040<sup>26,27</sup>. Krill and many other crustaceans depend on aragonite and calcite concentrations in the water and algae which is the most vital nutrient of Arctic ecosystem is also decline as this grows beneath the sea ice which affects the abundant of Bowhead whale due to decline to krill abundance<sup>28</sup>. According to Cotton *et al.*<sup>29</sup> Baleen whales and basking shark are dependent on abundant zooplankton either directly, or to nourish their prey such as krill, fish and cephalopod populations which also enhance their food availability. This is also applicable in some bird species such as Humboldt penguin, Balearic shearwater Bermuda petrel and short-tailed albatross. Doney<sup>30</sup> revealed study on correlation between zooplankton community and food web and concluded that many species will be negatively affected by changes in marine ecosystems and food-webs as increasing sea temperatures causes' zooplankton abundance to decline. Species dependent on calcite and aragonite concentration form the basis of food web in the arctic water seriously involve in destruction of entire ecosystem<sup>31</sup>. As zooplankton composition and abundance is changed, species such as whales and dolphins are also directly or indirectly suffer<sup>32-34</sup>.

Hawksbill turtles depend upon coral reef ecosystems to complete their life cycle. Coral reefs form shelves and caves which provide resting and sheltering areas for this species. Leon and Bjorndal<sup>35</sup> studied that hawksbill turtles feed exclusively upon coral reefs. According to Meehl *et al.*<sup>36</sup> reefs will suffer from severe acidification stress due to decrease aragonite concentration that will lead to fall in marine reef biodiversity in tropical seawater<sup>37</sup>. Numerous species are affected by ocean circulation as these will affect prey distribution. If the animal's species will have to survive then they must adapt their migration route<sup>38</sup>. Similarly, Humpback whale<sup>29</sup> and Basking shark<sup>28</sup> are affected by prey distribution.

## Conclusion

The ongoing climate change is a looming danger for wildlife from around the world, but we have only begun to scratch the surface. The majority of the species assessed by this review are already at high risk from anthropogenic pressures and high pollution. There is evidence that past climatic change increased overexploitation of many species. There is little is known fact and files about migratory species capacity for adaptation to climate change. If we are to gain a solid understanding of behaviour of migratory species and the impacts of climate change on migratory species, intensive monitoring and research is needed for the betterment of environment. The

negative socio-economic impacts of current climate change on humans will ultimately result in increased anthropogenic pressures on species and natural systems. For a viable conservation, linking individuals and populations in conservation oriented action plans and awareness will improve people understanding of the biological consequences of climate change on birds as well as fish and fisheries. Apart from that considerable reduction in CO<sub>2</sub> is a vital at least at the regional scale for the conservation of the biodiversity and environmental safety.

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