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Impact of Climate Change on Wildlife

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Abstract

Climate change is a major and growing threat to biodiversity worldwide. Affecting animals in all the ecosystem types. This study accounts for the various impacts of climate change on animal life, such as habitat loss, changes in migration and breeding, shifts in species distribution, increased extinction rates, and changes in ecosystem balance. Rising temperatures, changes in precipitation, and extreme weather are changing ecosystems faster than ever, increasing the number of species that barely survive. The study includes some important case studies including melting arctic ice, bleaching of coral reefs, deforestation crisis in the Amazon, and Australian fires in 2019-20. The authors present these examples as real-life examples of all the ways in which environmental changes caused by climate change are accelerating the decline of species globally. Importantly, endemic and specialized species are at an increased risk owing to their limited ability to adapt, both in terms of their capacity to do so and geographic limitations. Climate change allows for the further penetration of invasive species and wildlife diseases, posing even greater threats to biodiversity and fundamental ecosystem services that we depend on for pollination, seed dispersal, and water purification. These emergent species movements, both geographical and temporal, disrupt existing ecological networks, frequently creating new relationships while destabilizing existing networks. This paper describes the need for immediate conservation strategies from protected areas and species migration corridors to assist in the relocation and restoration of ecosystems, as well as global climate agreements and community-based mitigation. Through a synthesis of secondary data and comparative case analysis, the results add scope of the literature that suggests conservation with biodiversity considerations in climate change requires both immediate and long-term global initiatives. Supporting the resilience of ecosystems is critical for wildlife survival, as well as human existence on earth.

Keywords: *Climate change, biodiversity, wildlife, habitat loss, migration, extinction, ecosystems, global warming, species adaptation, conservation.*

Introduction

The climate of Earth is going through drastic and rapid change primarily from human activities such as burning fossil fuels for the power industry and transportation, deforestation for agriculture and timber, and use of chemical fertilizers, pesticides, and herbicides. The Intergovernmental Panel on Climate Change (IPCC) reported that since the pre-industrial period, the global average surface temperature has warmed by approximately 1.1°C, resulting in many consequential environmental effects. Most of the attention dedicated to climate change thus far has been focused on its effects on human beings and society; equally troubling, however, are its effects on wildlife. From polar regions to tropical rainforests and from oceans to alpine meadows, wildlife is struggling to keep pace with climate change. Wildlife is especially susceptible because its survival and behaviour are often dependent on stable environmental cues. Such environmental cues are undergoing change; no longer biological rhythms, ongoing interactions with ecosystem components, and climate and weather events conform to stable cues for wildlife.

Detailed Description:

Habitat loss and alteration

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The most evident and direct effect of climate change on wildlife is habitat loss, exacerbated by changing precipitation patterns, warming temperatures, sea level rise, and desertification, which are rapidly changing landscapes and ecosystems.

- **Habitat Loss Examples:**
- **Arctic**: As sea ice melts, species dependent on relatively stable sea ice hunting and breeding platforms (e.g., polar bear, walrus, arctic fox) are being threatened as they adapt to either open water conditions or tundra conditions.
- **Coral Reefs**: Increasing sea surface temperatures, and in conjunction with the acidification of oceans, create mass coral bleaching events that destroy coral reefs and habitats for thousands of marine organism species.
- **Forests**: If the climate zone changes, some species may not be able to migrate or adapt as quickly as needed. For example, boreal forests are moving north, but as boreal forests change and leave trees (for example) unable to track migration, the species may be left behind.

Causes of Habitat Loss and Alteration:

- **Urban Development**: Urban areas must constantly grow and consume the natural environment.
- **Agricultural Development**: Converting wildland to farmland removes natural habitat quickly and reduces biodiversity.
- **Deforestation**: Deforestation to harvest timber, wood pulp, or convert to land for development to remove or fragment habitat.
- **Pollution**: Toxic runoff or chemical gases in the atmosphere not only render habitats unliveable, but also degrade biodiversity.
- **Climate Change**: Changes the fundamental structure of ecosystems by changing their natural range (e.g., wetland drying and tundra warming).
- **Resource Extraction**: Mining and drilling impact broad swaths of land and the ecosystems within them.

Effects on Animals:

- **Disturbance**: Animals will leave, move, or die.
- **Habitat Fragmentation**: Animals become isolated as their habitat breaks into smaller patches, which can complicate movement, mating, and gene flow.
- **Loss of Biodiversity**: Specialists or animals that are limited by certain habitats are threatened the most.
- **Human-Wildlife Conflict**: Animals are displaced and seek food or shelter in urban areas.
- **Ecosystem Service**: Ecosystem services, such as pollination, natural pest control, and seed dispersal, can be decreased.

The Consequence for Wildlife

- Species Displacement: Animals will have to either move or die when their habitats are lost.
- Fragmentation: When habitats are divided into isolated patches, movement and breeding are restricted.
- Loss of Biodiversity: Specialized species will struggle to adapt and may die out.
- Increased Human-to-Wildlife Conflict: Animals will be moving into human-dominated environments to gain resources.
- Disruption of Ecosystem Services: Pollination, water purification, carbon sequestration, etc.

Climate Change as an Agent of Change

- Melting ice in the Arctic is destroying habitats for polar bears and seals.
- Rising sea levels are inundating coastal mangroves and wetlands.
- Desertification is extending into once-product land and reducing grassland systems.
- Forest fires are consuming large tracts of land because of higher temperatures.

Case Studies:

1. Amazon Rainforest: Deforestation of the rainforest for cattle ranching and the cultivation of soybeans is both reducing this important carbon sink and biodiversity.
2. Coral Reefs: Ocean warming and acidification are bleaching coral reefs and destroying the habitats of species that are dependent on coral reefs.
3. Australian Bushfires (2019–2020): More than 3 billion animals were affected (killed) by large-scale forest fires intensified by climate change.

Conclusion:

As human actions and climate change influence and transform the natural environment at a rapid pace, habitat loss and alteration continue to increase. It is therefore incumbent on us to act with urgency, presumably through a combination of conservation management, habitat restoration, sustainable development, and climate mitigation, to protect the remaining habitat and the species that depend on it.

Disruption of migration and reproductive cycles

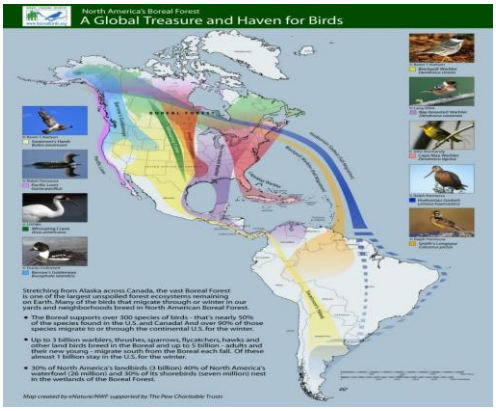
Climate change disrupts the important timing and cues that wildlife should rely on to migrate and reproduce. These disruptions can lead to mismatched timing of wildlife and food supply, as well as decreased reproductive success of the dependent species.

Impacts include:

1. **Bird migration**: Numerous bird species arrive at breeding habitats earlier in spring each year, in some cases before the peak hatching of insects, causing food shortages for hatchlings.
2. **Marine life**: Rising sand temperature during the incubation period of sea turtles causes their hatchlings to return to the ocean with skewed sex ratios, and the population dynamics yield imbalances.
3. **Amphibian and insect species**: Temperature fluctuation alters predator-prey interactions by timing hibernation, spawning, and emergence.

Consequences include:

- Reduced survival of offspring.
- Continuation of disrupted inter-species relationships, such as those between pollinators and plants.
- Population reduction over time due to reproductive failure.



Changes on the Distribution of Species

As the area of climate zones shifts, species move to cooler areas, either poleward or upward. This might allow a temporary escape from the effects of climate change, but also presents new problems.

General Trends:

1. Alpine Ecosystems: Species such as snow leopards and alpine flowers move to higher elevations, where there is limited habitat for them.
2. Marine Life: Fish stocks move toward the poles, which will have an effect on commercial fisheries and possibly traditional fishing communities.
3. Tropical Species: Some species in the tropics are unable to migrate because of narrow thermal tolerances or physical barriers to migration; these species will face greater mortality.
4. Ecological Impact: Some new species interactions might occur in new habitats and even lead to ecosystem instability.
5. Competition may become more common as invasive species migrate according to changes in climate and outcompete native species.

Increased Risk of extinction

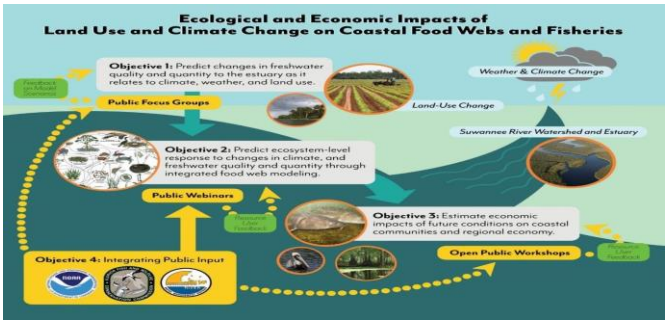
The combination of biodiversity loss (from habitat loss and fragmentation), disrupted life cycles, and diminished geographical range is increasing the extinction risk at an unprecedented scale and rate.

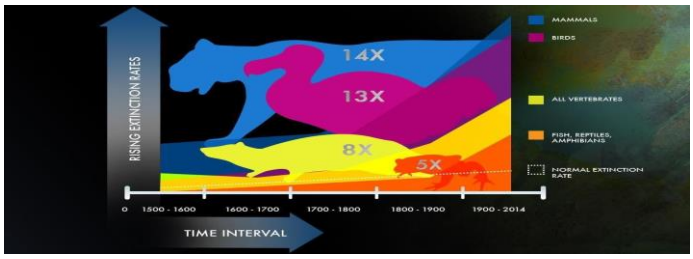
Examples of Extinctions:

- Golden Toad (Costa Rica): The Costa Rican Golden Toad is thought to be close to extinction, in part as a result of changes to the localized environment and becoming more vulnerable to illness.
- Bramble Cay Melomys (Australia): This mammal was declared extinct as a result of habitat submersion from sea-level rise -- the first mammal to become extinct as a direct impact of climate change.

At-Risk Groups:

- Endemic island species that have very limited dispersal options.
- Amphibians that are sensitive to changes in moisture and temperature.
- Arctic species that rely on consistent ice cover.
- Coral reef species that are sensitive to bleaching and acidification.





The graph below illustrates an increase in the loss of mammals, birds, fish, reptiles, and amphibians since 1500. Scientists continue to accumulate evidence that we are experiencing a Sixth Mass Extinction, which is speculated to be comparable to the extinction event that wiped out the dinosaurs.

Ecosystem Imbalance

Ecosystems operate as complex webs for species interactions. Climate change threatens to "unravel" these webs, which can have cascading consequences.

Disruptions Include:

Declines in pollinators: Bees and butterflies are especially sensitive to temperature changes, and decline can reduce food crops and wild-flowering plant diversity.

Predator-prey imbalances: Dramatic declines in apex predators can cause overgrazing pressure on plants or overpopulations of herbivores that degrade vegetation types.

Algae blooms: Warmer waters contribute to harmful algal blooms that consume oxygen and suffocate marine life.

Even small changes in the populations of keystone species can produce disproportionately large repercussions for the entire ecosystem.

Diseases and Invasive Species

Changes in climate can influence the distribution of diseases and invasive species**.**

Disease Spread:

- **Vector-Borne Diseases**: Higher temperatures will enable organisms, such as mosquitoes and ticks, to increase their geographical range, while they could also introduce infections in wildlife that will eventually impact humans (ex. avian malaria, and Lyme disease).
- **Climate stress can impair immunity**; climate-related stress can affect the immune responses of animals, making them more vulnerable to disease.

- **Invasive Species Spread:**
- **Example**, pine beetles in North America have expanded their geographical range with warmer winters and subsequently reduced the density of our coniferous forest.
- **Aquatic invaders:** Warmer water temperatures allow tropical marine species to invade temperate aquatic systems and cause a decline in established marine species.
- **Conservation and Adaptation**:
- This emerging threat must be addressed through timely and coordinated actions at multiple scales.

Conservation Measures:

- **Protected Areas:** expand and manage national and state parks, reserves, and marine protected areas.
- **Species Corridors:** develop ecological bridges and corridors to facilitate migration of species.
- **Restoration:** reforest degraded areas; restore wetlands; enhance seeded native vegetation.

Adaptation to Climate Change:

- **Assisted migration:** assist species relocation and movements to more suitable places.
- **Genetic Diversity**: Support and maintain genetic diversity via breeding programs.
- **Ecosystem-based approaches:** retain natural processes (e.g., burning regime, humidity, and water cycles).

Global Responsibility:

- Impose and abide by climate treaties (e.g., Paris Agreement).
- Promote sustainable land use.
- Act on indigenous knowledge and support for conservation and on-the-ground stewardship.

Research Methodology

This study utilizes a qualitative and exploratory structure while relying heavily on a variety of secondary data sources. The aim of this research is to conceptualize and synthesize the multifaceted impact of climate change on wildlife and ecosystems around the world. The methodology was as follows**:**

Data Collection:

- Secondary sourced data consisted of peer-reviewed journal articles, reports from global environmental organizations (such as the IPCC, WWF, IUCN, and UNEP), and accepted climate databases (NOAA and NASA).
- Case studies from a variety of ecological zones (polar, tropical, marine, and providing examples of short-term local impacts) were highlighted to provide an understanding of the persistent local effects of climate change on wildlife throughout the world**.**

Analysis:

- Usually, and generally, a content analysis is used in the data analysis process to identify reoccurring themes and trends in the secondary sourced data corresponding to habitat loss from ecosystems, disrupted migration patterns, habitat range changing past historical levels, increasing extinction risk of species, and strategies for the conservation of species.
- A comparative case analysis was employed to identify the variability in the impact of climate change on different species and habitats.

Scope and Limits:

- The impacts discussed in this study have a global view, but the limits of the study relied on access to the documentation of information. Thus, there was no production of time-sensitive species-specific field information in real-time.
- While the research was intended to be comprehensive, it focused as much as possible on illustrative examples, as opposed to a complete catalo of biodiversity.

Ethics:

- All sources of information documented in this report were from publicly available sources; therefore, proper attribution with proper citations. Human or animal testing was not conducted.

Literature Review

Many studies have outlined the negative impacts of climate change on biodiversity, and the following literature review outlines the most impactful and recent studies with a view to providing an academic foundation for current research.

Global Climate Trends and Biodiversity Change

- As evident in the IPCC (2021), there is a physical basis for global warming (i.e., heated global temperatures leading to habitat loss and/or a shift in ecological zones).
- Parmesan and Yohe (2003) provided the first evidence of climate-induced shifts in species ranges, as well as phenological changes across continents, followed by Walther et al. (2002).

Extinction Risk and Biodiversity Change

- Thomas et al. (2004) quantified the extinction risk for biodiversity loss under different warming scenarios and estimated that current rates could threaten 1/3 of the species with extinction.
- Pelc et al. (2017) reported biodiversity change and distribution with effects on ecosystems and

human systems, namely, food security and economic stability.

Habitat Loss and Coral Reefs

- WWF (2023) and IUCN Red List (2023) reported evidence of coral bleaching, melted glaciers, and deforestation, contributing to the decline and elimination of critical habitats for wildlife.
- Lovejoy and Hannah (2019) observed that biodiversity loss affects ecosystem services (loss of cleaning and filtration services) in a feedback loop, elevates ecosystem service roles, and Favors integrative solutions.

Disease Ecology and Range Expansion of Invading Species

- Bellard et al. (2012) and Scheffers et al. (2016) discussed how climate change could allow biological invasions to spread across a variety of taxa, with the possibility of new wildlife associated diseases, in addition to already stressed wildlife populations.

Conservation and Adaptive Change

- Dawson et al. (2011) called for "beyond predictions" to "adaptation-based" conservation strategies to include landscape connectivity, assisted migration, and community mobilization and involvement.
- The UNEP (2022) undertakes a framework pertaining to the Paris Agreement that acknowledges both reduced emissions and sustainable practices to consider how to create or avoid biodiversity collapse.

Conclusion:

The multiple impacts of climate change on animals, and thus on animal welfare, are unavoidable and intensive. A higher risk of extinction and habitat destruction, altered ecosystems, and emerging diseases adds incredible pressure to biodiversity on a global scale. However, a window of opportunity remains. Using conservation scientific approaches, restoring habitats, and employing climate mitigation strategies are ways to safeguard wildlife for future generations. The health of our planet relies on the resilience of the ecosystems – and their resilience relies on us.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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