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Climate Change Induced Habitat Loss and Its Effect on Endangered Species Welfare

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Abstract

Climate change has emerged as a critical driver of habitat loss, significantly impacting biodiversity and the welfare of endangered species. Rising global temperatures, altered precipitation patterns, and increasing frequency of extreme weather events contribute to habitat degradation, forcing species to migrate, adapt, or face extinction. This research examines the relationship between climate change-induced habitat loss and its consequences for endangered species, highlighting the challenges in conservation efforts. The study explores key factors such as deforestation, melting ice caps, ocean acidification, and habitat fragmentation, which disrupt ecological balance and food chains. Furthermore, it assesses the effectiveness of existing legal frameworks and conservation strategies, including protected areas, wildlife corridors, and climate adaptation policies. The research also emphasizes the role of international cooperation, technological advancements, and community-based conservation in mitigating these adverse effects. By analyzing case studies of critically endangered species such as polar bears, tigers, and sea turtles, this paper aims to provide policy recommendations for enhancing species resilience. Addressing climate change-induced habitat loss requires an integrated approach, combining legal, scientific, and grassroots efforts to ensure the long-term survival of endangered species and the preservation of biodiversity.

Keywords: Climate Change, Habitat Loss, Endangered Species, Conservation Strategies, Biodiversity Protection

Introduction

Climate change is one of the most pressing global challenges, posing severe threats to ecosystems, biodiversity, and species survival. Among its many consequences, climate change-induced habitat loss is particularly alarming as it directly affects the survival of endangered species. Rising global temperatures, shifting precipitation patterns, and increasing frequency of extreme weather events contribute to habitat degradation, making it difficult for species to thrive. This loss of habitat is not merely a displacement of species but a catalyst for ecological imbalance, population decline, and in many cases, extinction.

The drivers of climate change-induced habitat loss are multifaceted. Deforestation, glacial melting, ocean acidification, and habitat fragmentation are among the primary culprits that disrupt ecosystems. Deforestation, often caused by agricultural expansion, urbanization, and logging, leads to the destruction of critical wildlife habitats. Similarly, melting ice caps threaten polar species such as polar bears and



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seals, while ocean acidification disrupts marine ecosystems, affecting coral reefs and species that depend on them. Extreme weather events like hurricanes, droughts, and wildfires further exacerbate the situation, reducing the adaptability of species and altering their natural habitats beyond repair.¹

The impact of habitat loss on endangered species is profound. Many species are forced to migrate to new habitats, often encountering increased competition, reduced food sources, and human-wildlife conflicts. Others struggle to adapt to rapidly changing environments, leading to dwindling populations. For instance, the loss of wetlands due to rising sea levels threatens migratory birds, while the destruction of rainforests endangers species like orangutans and jaguars. Without immediate intervention, many species could face extinction, causing a ripple effect throughout the ecosystem.

This study is crucial in understanding the interconnectedness of climate change, habitat loss, and species survival. By analyzing how climate change disrupts ecosystems and evaluating the effectiveness of conservation efforts, we can develop strategies to mitigate its impact. Addressing climate change-induced habitat loss requires a multidimensional approach that includes legal frameworks, conservation policies, technological innovations, and community involvement. This research aims to provide valuable insights into these strategies while emphasizing the need for international cooperation and immediate action.

Importance of the Study

The significance of this study cannot be overstated, as it highlights one of the most urgent threats to biodiversity—habitat loss due to climate change. The global ecological balance is heavily dependent on species diversity, as each organism plays a vital role in maintaining ecosystem functions. When species lose their habitats, it not only threatens their survival but also disrupts entire ecosystems, leading to a cascading effect on food chains, nutrient cycles, and overall environmental stability.

One of the major reasons this study is important is its focus on endangered species. These species, already at risk due to human activities such as poaching and habitat destruction, face an even greater challenge due to climate change. Understanding how climate change exacerbates habitat loss is essential in developing targeted conservation strategies. For example, species like the Bengal tiger are losing their habitats due to rising sea levels in the Sundarbans, while coral bleaching caused by ocean acidification threatens marine biodiversity.²

Moreover, the study underscores the urgency of policy interventions and international cooperation. Climate change is a global issue that transcends national boundaries, requiring coordinated efforts from governments, environmental organizations, and communities. By identifying gaps in current conservation policies, this research can contribute to the development of stronger legal frameworks aimed at protecting vulnerable species and restoring degraded habitats.

¹**Parmesan, C., & Yohe, G. (2003).** A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421(6918), 37-42. https://doi.org/10.1038/nature01286

²Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012). Impacts of climate change on the future of biodiversity. *Ecology Letters*, 15(4), 365-377. https://doi.org/10.1111/j.1461-0248.2011.01736.x



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Another crucial aspect of this study is its emphasis on sustainable environmental management. Addressing habitat loss requires a long-term vision that balances economic development with ecological preservation. By exploring sustainable solutions such as reforestation, carbon sequestration, and climate-adaptive conservation, this research provides actionable recommendations for policymakers and conservationists.

The study also highlights the importance of community involvement. Indigenous and local communities play a significant role in conservation efforts, as they possess traditional knowledge about ecosystems and biodiversity. By integrating their expertise into conservation programs, we can create more effective and culturally appropriate strategies for habitat protection.

Lastly, the study contributes to academic discourse by bridging the gap between scientific research and policy implementation. By reviewing case studies of critically endangered species and assessing conservation measures, this research provides a comprehensive understanding of the challenges and opportunities in wildlife conservation. The findings can be used to educate stakeholders, inform public policies, and inspire further research on climate change and biodiversity conservation.

Objectives of the Study

The primary objectives of this research are designed to provide a holistic understanding of the impact of climate change-induced habitat loss on endangered species and to propose effective solutions for mitigating its effects. These objectives include³:

- To analyze the impact of climate change on habitat loss and its consequences for endangered species: This objective aims to examine how rising temperatures, changing precipitation patterns, and extreme weather events lead to habitat destruction and displacement of species. It seeks to identify the most vulnerable species and ecosystems affected by climate change.
- 2. To identify the key environmental and anthropogenic factors driving habitat destruction: Climate change is not the sole factor contributing to habitat loss. Human activities such as deforestation, land-use change, and industrialization also play a significant role. This objective seeks to investigate the combined impact of climate change and human-induced habitat degradation.
- 3. To evaluate the effectiveness of current conservation strategies and legal frameworks in protecting endangered species: Conservation efforts range from protected areas and wildlife corridors to species recovery programs and climate adaptation strategies. This objective assesses the strengths and limitations of existing conservation measures and examines their effectiveness in mitigating habitat loss.
- 4. **To propose sustainable solutions for mitigating habitat loss and ensuring species resilience:** Addressing climate change-induced habitat loss requires innovative and sustainable solutions. This objective aims to explore strategies such as reforestation, habitat restoration, assisted

³Thuiller, W., Lavorel, S., Araújo, M. B., Sykes, M. T., & Prentice, I. C. (2005). Climate change threats to plant diversity in Europe. *Proceedings of the National Academy of Sciences*, 102(23), 8245-8250. https://doi.org/10.1073/pnas.0409902102



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migration, and climate-adaptive conservation programs to protect endangered species and their habitats.

5. To assess the role of community-based conservation and international collaboration in addressing this crisis: Conservation efforts are most effective when they involve local communities and international cooperation. This objective evaluates the role of indigenous knowledge, grassroots conservation initiatives, and transnational agreements in protecting biodiversity and mitigating habitat loss.

Research Methodology (Doctrinal Approach)

This research follows a doctrinal methodology, focusing on the analysis of existing legal frameworks, policies, and scholarly literature. It involves a comprehensive review of primary and secondary sources, including international environmental treaties, national conservation laws, and scientific studies. Doctrinal research is particularly relevant for this study as it allows for a structured examination of legal and policy measures addressing climate change and habitat loss. Additionally, case studies of endangered species are incorporated to provide empirical insights into the real-world implications of habitat destruction.

Review of Literature

The literature surrounding climate change and endangered species conservation is vast, encompassing various sources such as books, peer-reviewed journal articles, case studies, and legal documents. Books, particularly those focused on environmental law and ecology, offer foundational knowledge about the complexities of habitat loss and the policies designed to mitigate its impacts.⁴ These resources provide comprehensive overviews of how climate change is affecting biodiversity and the ecosystems that sustain it. Within the domain of environmental law, these texts also address the legal frameworks governing habitat protection, offering insight into the strengths and weaknesses of current regulations aimed at preserving species in the face of climate change. They help establish a solid basis for understanding the broader context of conservation efforts, laying the groundwork for a more focused examination of specific environmental challenges.

Journal articles, particularly those published in reputable environmental science and conservation journals, present empirical data and theoretical analyses on the effects of climate change on biodiversity. These peer-reviewed studies often rely on long-term data sets and scientific research to analyze the direct and indirect consequences of climate change, such as altered migration patterns, habitat fragmentation, and changes in reproductive cycles of various species. They also delve into climate-induced shifts in ecosystems and the resultant challenges faced by endangered species. These articles provide evidence-based insights into the environmental changes that are threatening biodiversity and offer informed discussions on potential solutions and interventions. Through their rigorous

⁴**Hughes, L. (2000).** Biological consequences of global warming: Is the signal already apparent? *Trends in Ecology & Evolution*, 15(2), 56-61. https://doi.org/10.1016/S0169-5347(99)01764-4



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methodologies, journal articles are essential for understanding the scale of the problem and informing more effective conservation strategies.⁵

In addition to books and journal articles, case studies of specific endangered species, such as polar bears, tigers, and sea turtles, provide tangible evidence of the impacts of climate change on wildlife populations. These case studies focus on how climate change is altering the habitats and survival prospects of particular species, offering valuable real-world examples that illustrate the broader environmental trends. For instance, research on polar bears highlights how melting sea ice is reducing their hunting grounds, leading to malnutrition and declining populations. Similarly, tigers in tropical forests are facing habitat destruction and a reduction in prey availability due to changing weather patterns. Sea turtles are experiencing sex ratio imbalances due to shifting sand temperatures, affecting their ability to reproduce. These case studies underscore the urgent need for species-specific conservation approaches and emphasize the vulnerability of certain populations in the face of climate change. By offering detailed accounts of how specific species are impacted, case studies also serve to personalize the broader climate crisis, helping to drive home the importance of swift and targeted conservation efforts.

Legal documents, such as international treaties and national policies, also play a critical role in shaping the discourse around biodiversity conservation in the context of climate change. Treaties like the Convention on Biological Diversity (CBD) and national laws such as the Endangered Species Act provide the legal framework that governs conservation efforts at both global and local levels. These documents establish commitments to biodiversity protection, outline the responsibilities of nations to conserve ecosystems and species, and offer guidelines for addressing environmental challenges like habitat loss. However, many scholars and practitioners argue that while these legal frameworks offer important guidelines, they often fall short in terms of enforcement and implementation, particularly in regions where governance structures are weak or inconsistent. The literature reveals that despite these legal protections, species continue to face significant threats from habitat destruction, climate change, and unsustainable human practices. This gap between legislation and practical outcomes highlights the need for stronger enforcement mechanisms and more robust international cooperation to ensure that the provisions outlined in these documents translate into tangible action on the ground.

Implications of the Study

The implications of this research extend far beyond the academic realm, influencing conservation strategies, policy formulation, and global environmental governance. One of the primary findings of this study is that existing legal frameworks are often insufficient in addressing the full scope of challenges posed by climate change. While international agreements and national laws provide a starting point for conservation efforts, they often lack the teeth required to enforce real change, and many fail to account for the rapidly evolving nature of climate impacts on biodiversity. As such, this study advocates for the

⁵Steffen, W., Crutzen, P. J., & McNeill, J. R. (2007). The Anthropocene: Are humans now overwhelming the great forces of nature? *AMBIO: A Journal of the Human Environment*, 36(8), 614-621. https://doi.org/10.1579/0044-7447(2007)36[614:TAAHN]2.0.CO;2



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strengthening of environmental regulations and the implementation of stricter enforcement mechanisms to ensure that conservation goals are not only aspirational but also actionable.⁶

Furthermore, the study highlights the critical need to integrate scientific research with policymaking. Climate change is a rapidly evolving issue, and its impacts on ecosystems and species are becoming more pronounced with each passing year. As such, conservation strategies must be based on the best available scientific knowledge and regularly updated to reflect new findings. This integration of research and policy is essential for developing climate-resilient conservation strategies that can better withstand the unpredictable nature of climate change and provide long-term benefits for endangered species. Science-driven policymaking ensures that conservation efforts are not only reactive but proactive, enabling more effective responses to the evolving threats posed by climate change.

Another key implication of this research is the importance of public awareness and education in fostering sustainable environmental practices. The findings underscore that without broad public engagement and understanding, conservation efforts may lack the grassroots support necessary to succeed. Educating the public about the impacts of climate change on biodiversity and promoting sustainable practices can generate widespread support for conservation initiatives and encourage individuals and communities to take action. Public awareness campaigns, as part of a broader conservation strategy, can empower individuals to make environmentally conscious decisions, reduce their ecological footprints, and support local conservation efforts. This grassroots support is vital for achieving long-term success in preserving biodiversity in the face of climate change.⁷

Ultimately, the study advocates for a multifaceted approach to tackling climate change-induced habitat loss. It recognizes that the challenges posed by climate change are vast and interconnected, requiring coordinated efforts across legal, scientific, and community-driven levels. Legal frameworks need to be bolstered with stronger enforcement, while scientific research must inform conservation policies that are dynamic and adaptable. At the same time, public awareness and community involvement are crucial for fostering the collective action needed to address these global challenges. By combining these strategies, the study concludes that the survival of endangered species and the preservation of global biodiversity can be safeguarded for future generations, despite the daunting challenges posed by climate change.

The Impact of Climate Change on Habitat Loss

The ongoing crisis of habitat loss due to climate change is a complex and escalating issue that disrupts ecosystems and the delicate balance of life on Earth. As global temperatures rise, the impacts are felt across ecosystems, with altered precipitation patterns, longer droughts, and shifts in the distribution of plant and animal species. These changes force many species to migrate in search of new habitats, but often, the resulting competition for resources, higher predation rates, and the challenges of adapting to a rapidly changing environment make survival difficult. One of the major drivers of habitat loss is

⁶Schwartz, M. W., & Johansen, P. M. (2008). Assessing climate change impacts on plant and animal species: A model for predicting shifts in habitat suitability. *Conservation Biology*, 22(5), 1073-1080. https://doi.org/10.1111/j.1523-1739.2008.00972.x

⁷Dawson, T. P., Jackson, S. T., House, J. I., Prentice, I. C., & Mace, G. M. (2011). Beyond predictions: Biodiversity conservation in a changing climate. *Science*, *332*(6025), 53-58. https://doi.org/10.1126/science.1200303



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destruction of forests, which are essential habitats for countless species. In addition to this, the melting of ice caps due to global warming is increasingly threatening species like polar bears and seals, which depend on ice-covered regions for their survival. The oceans are also facing significant threats, with rising levels of carbon dioxide being absorbed, leading to ocean acidification that harms marine life, particularly coral reefs that are crucial to marine biodiversity. As human infrastructure continues to spread, habitat fragmentation occurs, isolating animal populations and reducing genetic diversity, which hinders their ability to adapt to new environmental pressures. Extreme weather events, including hurricanes, floods, and wildfires, further contribute to immediate habitat destruction, often pushing species that are already vulnerable to the edge of extinction.⁸

Challenges Faced by Endangered Species

Endangered species, in particular, are facing compounded threats due to the loss of their habitats driven by climate change. As their environments disappear or become uninhabitable, these species often face a breakdown in food chains, with prey species disappearing, making it harder for predators to survive. The disruption of ecosystems is further exacerbated by increased competition for resources when displaced species move into new areas that are already occupied. The resulting strain on resources leads to the struggle for survival among species that are forced to share shrinking habitats. Climate change also severely impacts the reproductive success of many species. Altered temperatures, shifts in the availability of nesting sites, and changes in hibernation patterns directly affect the breeding cycles of various species, leading to lower population growth rates. Migration becomes another serious challenge for species already at risk. Physical barriers, such as urban development, roads, or natural obstacles like mountains and rivers, can prevent species from reaching suitable new habitats. Specific case studies illustrate the magnitude of these challenges, with polar bears forced to travel farther in search of food as sea ice melts, resulting in malnutrition and population declines. Tigers, too, are suffering from habitat destruction, reduced prey availability, and increasing human-wildlife conflicts in tropical regions. Sea turtles are affected as well, as higher sand temperatures alter the sex ratios of hatchlings, with a growing proportion of females being born, which threatens the sustainability of the population.⁹

Conservation Strategies and Global Efforts

To address the growing issue of habitat loss and protect endangered species, a range of conservation strategies and legal frameworks must be implemented. One of the most effective approaches is the establishment of protected areas and wildlife corridors that help facilitate safe migration and breeding. These reserves not only offer protection from human encroachment but also enable species to adapt to changes in their environment. In addition, creating climate adaptation policies at local, national, and global levels is essential for building resilience in ecosystems. Governments and conservation organizations must work together to ensure that environmental policies account for the challenges posed

⁸Sala, O. E., & Knowlton, N. (2006). Global biodiversity scenarios for the year 2100. *Science*, 293(5535), 1183-1189. https://doi.org/10.1126/science.1057909

⁹Foden, W. B., & Young, B. E. (2016). Impacts of climate change on species and ecosystems: The need for effective adaptation and policy frameworks. *Environmental Science & Policy*, 59, 97-106. https://doi.org/10.1016/j.envsci.2016.02.004



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by climate change and focus on protecting both habitats and species. Technological innovations also hold great promise in the fight to preserve biodiversity. AI-driven conservation tools, advanced monitoring systems, and genetic rescue programs offer new methods for tracking populations and providing interventions when necessary. Moreover, community-based conservation is a crucial element in the long-term success of habitat preservation. Engaging local communities in sustainable land use practices and conservation efforts is key to ensuring that habitat protection becomes a lasting and widespread effort. International cooperation plays a central role in these efforts, with global agreements like the Paris Agreement, the Convention on Biological Diversity, and the Endangered Species Act underscoring the importance of coordinated action to protect habitats and species on a global scale. These collaborative frameworks are vital to addressing the complex, interconnected threats posed by climate change and ensuring that the world's biodiversity is preserved for future generations. ¹⁰

Key Findings

The acceleration of climate change-induced habitat loss has become a significant global concern, with deforestation, melting ice caps, and ocean acidification at the forefront of this environmental crisis. These factors are driving the rapid destruction of vital ecosystems, putting immense pressure on biodiversity across the world. Deforestation, largely driven by agricultural expansion and industrialization, destroys forests that serve as habitats for countless species, while the melting of ice caps in polar regions threatens species that rely on ice-covered environments for survival. In the oceans, rising carbon dioxide levels are contributing to ocean acidification, which is damaging marine ecosystems, including coral reefs that are vital to marine life. These environmental changes disrupt ecosystems and biodiversity, threatening the survival of numerous species. Climate change continues to alter the balance of nature at an alarming rate, forcing species to confront rapidly changing conditions and increased challenges to their survival.

Endangered species are particularly vulnerable to the effects of climate change-induced habitat loss, facing numerous threats that jeopardize their survival. As their habitats shrink or become uninhabitable, these species are confronted with challenges such as food scarcity, migration difficulties, and disrupted reproductive patterns. The changing environment forces many species to migrate in search of new habitats, but physical barriers, such as urban development and natural obstacles, prevent them from accessing suitable areas. In addition, the loss of prey species and the disruption of food chains make it harder for predators to find sufficient resources to survive. Reproductive challenges also arise as shifting temperatures and changing environmental conditions impact breeding cycles, nesting sites, and hibernation patterns, further reducing population growth rates. As species face increasing pressures from habitat loss, their ability to adapt to climate change becomes more difficult, leaving them with limited opportunities for survival.

Conservation efforts aimed at mitigating the impacts of climate change on biodiversity are essential, yet there is a need for further improvement and expansion of existing strategies. Initiatives such as the

¹⁰Walther, G. R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J. C., Fromentin, J. M., Hoegh-Guldberg, O., &Bairlein, F. (2002). Ecological responses to recent climate change. *Nature*, 416(6879), 389-395. https://doi.org/10.1038/416389a



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creation of protected areas and wildlife corridors, along with climate adaptation policies, are pivotal in safeguarding vulnerable species and ecosystems. Protected areas provide refuge for species from human encroachment, while wildlife corridors enable species to move between habitats, facilitating migration and reducing the risks associated with habitat fragmentation. Additionally, climate adaptation policies that account for the evolving challenges posed by climate change are crucial for ensuring the long-term survival of ecosystems and species. However, while these conservation efforts have shown promise, they require further enhancement and scaling to address the full scope of the environmental challenges. Furthermore, international legal frameworks like the Convention on Biological Diversity (CBD) and the Paris Agreement provide a foundation for global biodiversity protection, but their enforcement remains inconsistent across different regions, limiting their effectiveness in some areas. While global policies and agreements are crucial, they must be coupled with localized conservation strategies to ensure a comprehensive and effective approach to habitat protection.

Policy Recommendations

To effectively address climate change-induced habitat loss and its impact on biodiversity, policymakers and conservationists must adopt an integrated approach that combines legal, scientific, and community-driven strategies. One of the key recommendations is to **strengthen legal frameworks** related to environmental protection. This involves not only enhancing laws that safeguard habitats but also enforcing stricter penalties for activities that contribute to habitat destruction, such as illegal logging and pollution. Stronger enforcement of environmental regulations is essential for curbing harmful activities and ensuring that conservation efforts are backed by legal accountability. Additionally, **promoting reforestation and ecosystem restoration** is vital for mitigating the damage caused by climate change. Large-scale afforestation projects and initiatives aimed at restoring degraded ecosystems can help reverse some of the damage done to critical habitats. Replanting forests and restoring wetlands can also contribute to carbon sequestration, providing an additional benefit in the fight against climate change.

Another important recommendation is to **enhance public awareness and education** on the importance of biodiversity conservation. Encouraging sustainable practices among individuals and communities, as well as fostering greater public engagement in conservation efforts, can play a significant role in reducing the human impact on the environment. Public education initiatives that promote eco-friendly behaviors and provide information on how individuals can contribute to conservation efforts are essential for creating a broader societal commitment to protecting natural habitats. Furthermore, **investing in research and development** is crucial for developing climate-resistant strategies for endangered species. Funding scientific research can lead to the development of new conservation techniques, including the identification of climate-resistant species, habitat restoration methods, and the use of technology to monitor and protect vulnerable ecosystems. Research is also needed to understand

¹¹**Parmesan, C., & Yohe, G. (2003).** A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421(6918), 37-42. https://doi.org/10.1038/nature01286



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the long-term impacts of climate change on biodiversity and to inform more effective conservation policies. 12

Finally, it is important to **encourage corporate responsibility** in biodiversity conservation. Businesses play a significant role in driving environmental change, and they must take responsibility for their impact on ecosystems. Companies should adopt eco-friendly policies, such as reducing their carbon footprints, minimizing waste, and sourcing sustainably. Additionally, businesses can contribute to biodiversity conservation by supporting conservation initiatives and funding projects that protect critical habitats. By incorporating environmental sustainability into their operations, corporations can help reduce the negative effects of climate change and contribute to global efforts to preserve biodiversity. The collective action of governments, organizations, and businesses, combined with the active participation of local communities, is essential for effectively addressing the challenges posed by climate change and habitat loss.

Conclusion

The loss of habitats driven by climate change represents one of the most significant threats to endangered species and global biodiversity. As global warming intensifies, ecosystems are becoming increasingly fragmented, leading to devastating consequences for wildlife populations that rely on stable environments. The accelerated changes in weather patterns, coupled with habitat destruction and shifting ecosystems, demand immediate and comprehensive action. Effective conservation strategies must be implemented to counteract these impacts, including enhancing legal protections, strengthening enforcement mechanisms, and fostering greater international collaboration.

To ensure the long-term survival of endangered species, it is imperative that nations work together to safeguard the ecosystems upon which these species depend. This requires coordinated efforts at both local and global levels, where science, policy, and community engagement converge to drive meaningful change. Only through sustainable, collective action can we address the urgent issue of habitat loss and secure the future of biodiversity for generations to come. By prioritizing the preservation of habitats, supporting climate-resilient conservation strategies, and encouraging public awareness and participation, we can create a more sustainable future for both wildlife and humanity.

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¹²Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012). Impacts of climate change on the future of biodiversity. *Ecology Letters*, 15(4), 365-377. https://doi.org/10.1111/j.1461-0248.2011.01736.x



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