Executive Summary

Climate change significantly impacts species adaptation across various ecosystems, with Arctic species, coral reefs, forest ecosystems, and marine life undergoing notable shifts in response to changing environmental conditions.

Arctic species, particularly polar bears and beluga whales are experiencing alterations in their migratory behaviors, genetic diversity, and feeding habits due to diminishing sea ice and shifting prey distribution. Studies indicate that polar bears modify their movement patterns in response to ice loss, while beluga whales display metabolic and dietary adjustments to environmental fluctuations. Habitat fragmentation resulting from ice reduction has also led to genetic differentiation among polar bear populations, raising concerns about their long-term survival. Similarly, the little auk, a key Arctic avian predator, faces declining survival rates due to warming-induced shifts in prey availability. Other marine mammals, such as narwhals, exhibit changes in migration routes and habitat selection as they seek cooler waters to mitigate the impacts of rising ocean temperatures.

Coral reefs and oceanic species are also vulnerable to climate-induced changes, particularly ocean acidification and warming sea temperatures. Research highlights that some marine organisms, including corals and mollusks, exhibit physiological and genetic plasticity to cope with acidification. However, others lack adaptive capacity, leading to biodiversity losses and ecosystem instability. The metabolic and oxidative stress caused by increasing sea surface temperatures negatively affects highly migratory Arctic seabirds, such as Arctic terns and long-tailed jaegers, reducing their reproductive success and overall fitness.

Forest ecosystem species, such as caribou, experience migration timing and habitat use disruptions due to shifting temperature and precipitation patterns. Climate variability influences their movement strategies, affecting their access to food resources and exposure to predators. These findings underscore the complex interplay between climate factors and terrestrial species' adaptive mechanisms, highlighting the need for conservation measures that consider both short-term weather fluctuations and long-term climate trends.

Marine species are particularly susceptible to warming ocean temperatures, which alter metabolic rates and interspecies competition. Research on sculpins in Greenland reveals that higher temperatures increase metabolic demands, fostering competition for limited resources. These ecological shifts can modify species dominance and alter the structure of marine communities. Similarly, narwhals have demonstrated behavioral adaptations to rising sea temperatures, but their ability to sustain population levels in a rapidly changing environment remains uncertain.

The broader implications of these studies emphasize the urgent need for conservation strategies to mitigate biodiversity loss. The genetic differentiation observed in polar bear populations due to habitat fragmentation highlights the long-term risks associated with climate-induced genetic erosion. Conservationists stress the importance of habitat preservation and genetic diversity maintenance to ensure species resilience in the face of climate change. Furthermore, the ability of marine organisms to adapt to acidification underscores the importance of targeted conservation efforts to protect vulnerable species and maintain ecosystem balance.

In conclusion, climate change presents multifaceted challenges to species adaptation across diverse ecosystems. While some species exhibit remarkable resilience through behavioral

and physiological adaptations, others face increasing threats to their survival. Understanding these adaptation mechanisms is crucial for developing effective conservation policies and mitigating the long-term impacts of climate change on global biodiversity.