

geographical ranges, often towards the poles or higher elevations (Kerr, 2020). These shifts can result in mismatches between species and their habitats, increasing the risk of local extinctions. For instance, the study on *Pseudolarix amabilis* highlights how climate change affects species with limited dispersal abilities, suggesting that such species may not fully adapt to new climatic conditions without human intervention (Bai et al., 2018). Furthermore, climate change impacts are often mediated by biotic interactions, such as changes in food availability and predation, which can be more significant than direct abiotic effects.

4.2 Habitat destruction and fragmentation: anthropogenic impacts

Habitat destruction and fragmentation, primarily driven by human activities such as deforestation, urbanization, and land-use change, are critical threats to biodiversity (Sirami et al., 2017). These processes reduce available habitat, isolate populations, and disrupt ecological corridors, leading to declines in species diversity and abundance. The lack of integration between climate change and land-use change studies hampers the development of effective conservation strategies, as these drivers often interact to exacerbate species endangerment. Conservation efforts must prioritize habitat preservation and restoration to mitigate these impacts, focusing on creating ecological corridors and rehabilitating degraded habitats.

4.3 Pollution and its influence on population viability

Pollution, including air and water pollution, poses significant threats to species viability, particularly in aquatic ecosystems (Mulinge, 2023). Pollutants can lead to habitat degradation, reduce reproductive success, and increase mortality rates, thereby decreasing population viability. The effects of pollution are often compounded by other environmental stressors, such as climate change, which can alter the distribution and abundance of species, further threatening their survival. Effective environmental policies and regulations are essential to mitigate pollution's impact on biodiversity and promote sustainable practices.

4.4 Invasive species and their disruptive effects on native ecosystems

Invasive species are a major threat to native ecosystems, often outcompeting native species for resources and altering habitat structures. These species can introduce new diseases, predation pressures, and competition, leading to declines in native biodiversity. The impact of invasive species is particularly pronounced in ecosystems already stressed by other environmental changes, such as climate change and habitat destruction (Ducatez and Shine, 2017). Addressing the threat of invasive species requires comprehensive management strategies that include prevention, early detection, and rapid response to invasions, as well as restoration of affected ecosystems.

5 Mechanisms Driving Species Endangerment

5.1 Loss of genetic diversity and evolutionary potential

The loss of genetic diversity is a critical mechanism driving species endangerment, as it directly impacts a species' ability to adapt to changing environmental conditions. Genetic diversity is essential for the evolutionary potential of species, allowing them to respond to environmental pressures such as climate change and habitat destruction. Studies have shown that habitat loss and fragmentation significantly reduce genetic diversity in mammalian populations, leading to decreased allelic richness and heterozygosity, which are vital for adaptive potential. Furthermore, the reduction of genetic diversity in threatened vertebrates has been linked to inbreeding and genetic drift, which further exacerbate the risk of extinction (Willoughby et al., 2015).

In the context of the Anthropocene, human-induced habitat changes have accelerated the loss of genetic diversity across ecosystems. This loss is not only a concern for currently threatened species but also for those not yet classified as endangered, as their populations and geographic ranges shrink, potentially leading to a rapid decline in genetic diversity (Expósito-Alonso et al., 2021). The reduction in genetic diversity is particularly pronounced in species with large body mass and those dependent on specific habitats, such as forest-dependent species, which are more susceptible to the negative effects of habitat fragmentation (Lino et al., 2019). These findings underscore the importance of preserving genetic diversity to maintain the evolutionary resilience of species in the face of ongoing environmental changes.