

Perspective

Wildlife corridors as a tool for conserving genetic diversity

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The accelerating pace of habitat loss and fragmentation caused by human activities such as deforestation, agriculture, infrastructure development, and urban expansion poses one of the greatest threats to global biodiversity. As habitats shrink into isolated patches, wildlife populations become separated, reducing opportunities for dispersal, gene flow, and interbreeding. This isolation increases the risk of inbreeding depression, loss of adaptive potential, and eventual population decline or extinction. Wildlife corridors, defined as linear landscape features or habitat linkages that connect fragmented ecosystems, have emerged as a critical conservation strategy to mitigate these challenges. By facilitating movement between habitat patches, corridors enhance genetic exchange, reduce population isolation, and maintain ecological processes. They also provide migration routes, promote species resilience under climate change, and sustain ecosystem services. This article explores the importance of wildlife corridors as tools for conserving genetic diversity. It discusses the ecological and genetic significance of connectivity, evaluates the effectiveness of corridors in various contexts, highlights real-world examples, addresses implementation challenges, and outlines future directions for integrating corridor design into sustainable conservation and land-use planning.

Keywords: Wildlife corridors, Genetic diversity, Habitat fragmentation, Biodiversity conservation, Ecological connectivity, Gene flow, Conservation biology, Landscape ecology, Sustainable management, Climate adaptation.

Introduction

Genetic diversity is the foundation of evolutionary potential and ecological resilience. It allows populations to adapt to environmental change, resist diseases, and maintain overall viability. However, human-induced habitat fragmentation increasingly isolates wildlife populations, reducing effective population sizes and limiting opportunities for gene flow. Small, isolated populations often suffer from inbreeding depression, accumulation of deleterious mutations, and reduced adaptive capacity. Over time, these genetic consequences can undermine species survival, even if the habitat fragments themselves remain intact. Conservation biology therefore emphasizes not only the protection of individual habitats but also the preservation of connectivity between them. Wildlife corridors have been proposed and implemented as practical tools for counteracting the negative genetic impacts of fragmentation. By linking habitat patches, corridors allow organisms to disperse, interbreed, and exchange genetic material, thus sustaining population health and long-term survival (Mata C, et al. 2008). Their importance has become even more pronounced in the face of climate change, which forces species to shift ranges in search of suitable habitats.

The rationale for wildlife corridors lies in the principle of connectivity. Ecosystems function as networks rather than isolated patches, and species depend on movement across landscapes for foraging, breeding, seasonal migration, and colonization of new habitats. Corridors, whether natural or human-designed, maintain these connections. They can take many forms, including riparian strips along rivers, hedgerows, forested strips between agricultural fields, overpasses and underpasses across roads, and large-scale landscape linkages across regions (Lesbarreres D, et al. 2012).

Description

Corridors also have ecological benefits beyond genetic diversity. They allow species to track shifting climate envelopes, thereby functioning as adaptation pathways under global warming. As temperature and precipitation patterns change, many species must migrate northward, upward, or into previously unsuitable areas. Without connectivity, such range shifts may be impossible, resulting in population declines. Corridors thus serve as lifelines under climate change, enabling ecological processes to continue. Additionally, corridors sustain ecosystem services by maintaining populations of pollinators, seed dispersers, and predators across landscapes, thereby supporting agriculture and forest regeneration (Torres A, et al. 2016).

Numerous real-world examples illustrate the effectiveness of wildlife corridors. In India, the establishment of corridors linking tiger reserves in the Western Ghats and central India has been critical for sustaining viable metapopulations. Genetic studies confirm that tigers moving through these corridors contribute to gene flow, enhancing population resilience. In North America, the Yellowstone-to-Yukon Conservation Initiative (Y2Y) represents one of the largest corridor projects, spanning thousands of kilometers to connect wildlife habitats across the United States and Canada. This initiative supports wide-ranging species like grizzly bears, wolves, and elk, ensuring that populations do not become genetically isolated (Dickson BG, et al. 2019). In Europe, the Pan-European Ecological Network aims to link protected areas across national borders, emphasizing the role of corridors in conserving migratory birds and large mammals. Even at smaller scales, urban wildlife corridors such as green belts and vegetated overpasses facilitate the movement of species like hedgehogs, amphibians, and reptiles, highlighting the universality of corridor benefits.

However, the design and implementation of corridors face challenges. Not all corridors are equally effective, and poorly designed ones may act as ecological traps, exposing animals to risks such as predation, human conflict, or road mortality. Corridors must be wide enough, ecologically suitable, and strategically located to facilitate safe passage. They also require political will, funding, and cooperation across landowners, governments, and communities. Land-use conflicts, infrastructure expansion, and competing development priorities often constrain corridor establishment. Additionally, monitoring corridor effectiveness demands long-term data on animal movement, genetic diversity, and ecological outcomes, which can be resource-intensive. Critics argue that corridors may divert attention from protecting core habitats, which remain essential for species survival (Tucker MA, et al. 2018). Nevertheless, the consensus in conservation science is that corridors complement protected areas rather than replace them, and both strategies are necessary for safeguarding biodiversity.

Conclusion

Wildlife corridors represent one of the most practical and scientifically grounded strategies for conserving genetic diversity in the face of habitat fragmentation and climate change. By facilitating movement and gene flow, corridors sustain evolutionary potential, reduce extinction risks, and maintain ecosystem processes. They also provide adaptation pathways for species responding to global change and contribute to the resilience of socio-ecological systems. While challenges exist in design, funding, and implementation, the benefits of corridors are well-documented across diverse contexts. Their integration into conservation planning reflects a shift toward holistic, landscape-based management that recognizes the interconnectedness of ecosystems. Ultimately, conserving genetic diversity through corridors is not only a biological necessity but also a moral responsibility to preserve the evolutionary legacy of life on Earth. Future conservation strategies must prioritize the identification, establishment, and maintenance of corridors as integral components of sustainable land-use planning. Only by safeguarding connectivity can humanity ensure that wildlife populations retain the genetic diversity essential for survival in a rapidly changing world.

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Conflict of Interest

The authors declare no conflict of interest.

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