Global meta-analysis shows action is needed to halt genetic diversity loss

POLICY BRIEF

Policy brief for publication: Shaw & Farquharson et al. 2025. Global meta-analysis shows action is needed to halt genetic diversity loss. *Nature*. https://doi.org/10.1038/s41586-024-08458-x

Executive Summary

A meta-analysis of all published data measuring genetic diversity over time has shown that genetic diversity is being lost globally. Threats to populations were more commonly reported than conservation management actions. These patterns suggest that human activities (e.g. land use change, introduced disease, and harvesting and harassment) are negatively impacting genetic diversity within species. However, conservation management actions show promise in maintaining or even increasing genetic diversity, including:

- Supplementing new individuals into a population from elsewhere
- Population control to improve conditions for remaining individuals
- Improving environmental conditions through ecological restoration
- Controlling feral and pest species

"Global genetic diversity loss can be mitigated by conservation action if we are intentional and act now"

Background

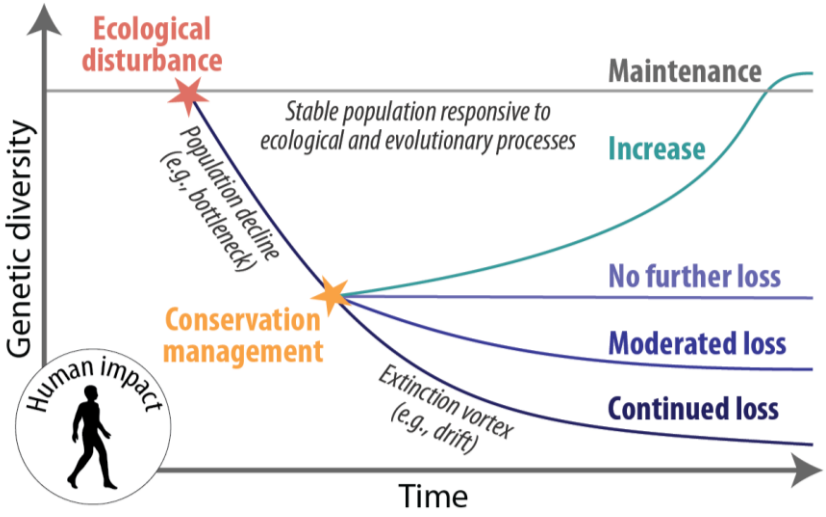
Genetic diversity is essential for species' resilience

Genetic diversity provides the capacity for individuals and populations to respond to environmental changes. However, anthropogenic ecological disturbances can erode genetic diversity and the ability of species to adapt. This puts the survival of populations at risk.

In recognition of the importance of genetic diversity, the Convention on Biological Diversity's Kunming–Montreal Global Biodiversity Framework now includes targets for safeguarding the genetic diversity of all species.

Understanding genetic diversity decline is key for conservation prioritisation

An international team of researchers conducted a temporally, spatially, and taxonomically comprehensive census of genetic diversity change, alongside information about ecological disturbance and conservation management, to find out if genetic diversity is declining and if conservation actions can help reverse these losses. This information is essential to biodiversity policy prioritisation, risk assessment, and landscape management.



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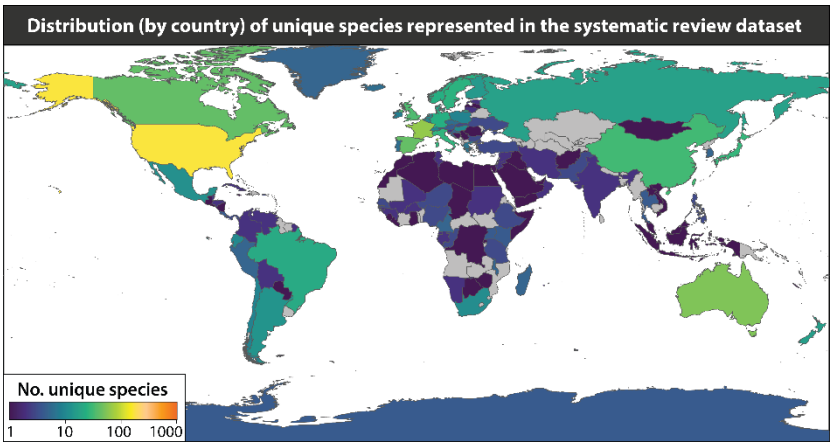
How can genetic diversity be better integrated into policy and practice?
Explore resources at the Coalition for Conservation Genetics: coalitionforconservationgenetics.org

How was global genetic diversity change measured?

A systematic review of the scientific literature identified 80,271 published studies, of which 882 (1.1%) were includable. These studies included 628 species, three decades of research, and 141 countries, representing all terrestrial and most marine realms on Earth. Patterns of average genetic change across this dataset were analysed using meta-analysis.



What was the extent and pattern of genetic diversity change?

A loss of genetic diversity was found across all terrestrial realms, some marine realms and many taxonomic classes. Loss was detected across different study designs and methods, and regardless of IUCN Red List threat status or whether any ecological disturbances or conservation management actions were reported. This overall result suggests a **background level of genetic diversity loss across species**, particularly where **land use change**, **disease**, **abiotic natural phenomena** and **harvesting or harassment** were reported.

What conservation actions maintain or improve genetic diversity?

On average, genetic diversity was maintained or increased when several conservation actions were reported, including **supplementation** (e.g. introducing new individuals into a population through translocation or restoring connectivity), **population control** (e.g. removal of some individuals to improve conditions for those that remain), **ecological restoration**, and **controlling feral or pest species.**

Recommendations based on our analysis

1. *Conduct temporal genetic monitoring:* Genetic diversity metrics are sensitive to change. Monitoring genetic diversity alongside threats and conservation action can inform strategic management.
2. *Begin collecting now*: Single snapshots of genetic diversity provide valuable baselines for future comparisons and to guide management decisions.
3. *Where genetic data collection is difficult, utilise existing data:* This analysis identified hundreds of datasets that can serve as a starting point for management efforts.
4. *Where genetic data are absent, use proxies*: Genetic considerations should inform any biodiversity risk assessment, even if based solely on ecological proxies.

Further loss of genetic diversity is likely unless urgent action is taken. This global analysis highlights that **effective conservation approaches already exist**, along with **sensitive methods and datasets** that allow us to **target these actions strategically**. By integrating genetic considerations into conservation planning and implementation, we can safeguard biodiversity and strengthen ecosystem resilience against current and future challenges.

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Have questions or want to learn more?
Read the full paper here: https://doi.org/10.1038/s41586-024-08458-x
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