

Protecting genetic diversity to benefit nature and society

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There are three ways that governments and other conservation actors at all levels can monitor and protect genetic diversity, supporting the attainment of biodiversity goals and targets. But first, what is genetic diversity, and is there potential to safeguard it better?

Genetic diversity refers to variation within species, including DNA differences among individuals and populations, and contributes to the traits and survival of organisms. Genetic diversity is the foundation of a species' ability to adapt to changing environments and promotes the resilience of species and ecosystems to environmental disturbances and climate change. Genetic diversity also helps ensure successful ecological restoration and food security.

Reflecting the trend in global biodiversity loss, genetic diversity has experienced substantial decline. Halting this loss and restoring genetic diversity is urgently needed to maintain species and vital ecosystem functions and services.

The potential to better safeguard genetic diversity

Fortunately, the potential to better safeguard genetic diversity has reached a pivotal moment. The United Nations Convention on Biological Diversity (CBD) Kunming-Montreal Global Biodiversity Framework (GBF), adopted in December 2022 at the 15th Conference of the Parties (COP15), recognizes and commits to conserving and restoring genetic diversity. Through direct engagement with CBD negotiations, geneticists helped improve GBF Goals and Targets by more clearly incorporating the protection of genetic diversity (Hoban et al., [2023]).

The final Goal A states, "The genetic diversity within populations of wild and domesticated species, is maintained, safeguarding their adaptive potential," and Target 4 states, "maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex-situ conservation and sustainable management practices". Parties to the CBD are now required, and other entities, from subnational governments to NGOs to communities, are invited to work towards accomplishing Goal A and Target 4.

How can governments and other conservation actors monitor and protect genetic diversity?

The Coalition for Conservation Genetics (Kershaw et al. [2022]) offers three recommendations to advance these critical efforts:

1.

1. Use genetic indicators to assess and monitor within-species genetic diversity status and trends
 - Genetic indicators are proxy-based metrics that offer a pragmatic, fast, affordable, and reliable tool by which all actors, including Parties to the CBD, can report genetic diversity, and better understand and mitigate in-country genetic biodiversity loss (Hoban et al. [2023], Mastretta-Yanes et al. [2023]). A CBD GBF “Headline indicator” is “The proportion of populations within species with an effective population size > 500”, which generally corresponds to a “genetically safe” census population size of approximately 5000 (Hoban et al. [2021]).
 - Several “complementary indicators” exist. “The proportion of populations maintained within species” helps document the loss of genetic distinctiveness and local adaptation of populations. The “genetic scorecard” – first implemented by Scotland under the Aichi Targets – summarizes the overall genetic picture for a species in a concise manner (Hollingsworth et al. [2020]). Several indicators have been piloted in nine countries across six continents to guide their effective implementation (Hoban et al. [2023]; Mastretta-Yanes et al. [2023]).
 - Importantly, data are available to calculate genetic indicators across geographies, and data collection is practical, achievable, and adaptable (Hoban et al. [2023]). Alongside genetic indicators, countries should also invest in monitoring using DNA-based assessments (Pearman et al. [2024]).
2. Include genetic diversity targets in national legislation and/or policies or plans, and develop clear strategies and funding streams for implementation
 - Explicitly including genetic diversity targets in national legislation, policies, and plans will elevate the issue and help ensure sufficient funding is made available for effective implementation. Genetic diversity is already protected under national legislation in the U.S., Canada, and Australia. Attainment of genetic diversity targets is contingent on developing detailed, well-resourced national strategies that define the actions, procedures, and capacity needs for monitoring genetic diversity and priority species for genetic monitoring.
 - The IUCN (Hvilsom et al. [2022]) has articulated how genetic diversity has and can be incorporated into spatial planning, identifies needs regarding the development (or enhancement of existing) databases for genetic diversity monitoring data, and sets timelines for capacity building, among others. The Coalition for Conservation Genetics and colleagues are also working on guidance for developing such plans, including CBD-required National Biodiversity Strategy and Action Plans. (Commitments and plans can be reported using [this CBD tool](#)).

3. Recognize Indigenous Peoples and local communities as genetic diversity knowledge holders with the right to retention and control of their data
 - Indigenous Peoples and local communities hold deep knowledge of biodiversity, including genetic diversity, such as names for, and knowledge of, the place history, life history, and unique properties (e.g., unique adaptations or distinct qualities or characters) of different species, subspecies, and genotypes, among others (Des Roches et al. [2021]).
 - This knowledge should be recognized, and Indigenous Peoples and local communities are invited to engage and partner in the co-creation and implementation of genetic monitoring plans, including with indicators.
 - In such partnerships, data provided by Indigenous Peoples and local communities must be collected and curated ethically and responsibly (Jennings et al. [2023]). Adherence to the “CARE [collective benefit, authority to control, responsibility, and ethics] Principles for Indigenous Data Governance” (Carroll et al. [2020]) should form a central tenet of any genetic monitoring partnership.

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