

The Coalition for Conservation Genetics statement on genetic diversity in the CBD post-2020 Global Biodiversity Framework and Proposed Indicators.



We, the Coalition for Conservation Genetics (www.coalitionforconservationgenetics.org/about-us), provide this Statement on vital considerations for genetic diversity at COP15.

Background: Genetic diversity is a basic pillar of all biodiversity that *must be maintained, protected, managed, and monitored* to enable populations of all species to adapt to environmental change, ensure resilient ecosystems, support ecosystem function, and benefit humanity. Genetic diversity of populations is also a key barrier against diseases, invasive pests, and climate change. Loss of genetic diversity will reduce adaptation, increase extinctions, destabilize ecosystems, and harm human well-being and economies (see [Hoban et al 2021](#)).

We commend the progress made towards **conserving the genetic diversity of all species**, as reflected in the OEWG4 and October 2022 Informal Group work on Goal A text and Action Target 4. Further, we welcome and strongly support the Headline Indicator (A.5, previously A.0.4): *“The proportion of populations within species with a genetically effective population size (N_e) >500”* and we support the list of other indicators on genetic diversity which are vital (see below).

However, Goal A and targets require additional clarification, specificity and ambition, and indicators can be strengthened. Based on available, peer reviewed scientific knowledge, we suggest specific changes in the Tables below.

Table 1. Goals and Targets Relating to Genetic Diversity

Text from the Informal Group	Suggested text, mostly using text from the brackets	Comments
<p>Goal A: The genetic diversity and adaptive potential of [all] [known] [wild and domesticated] species is safeguarded and [all genetically distinct populations are] maintained [by 2030, at least [95] per cent of genetic diversity among and within populations of [native] [wild and domesticated] species is maintained by 2050].</p>	<p>Genetic diversity and adaptive potential within populations of all [wild and domesticated] species is safeguarded, all genetically distinct populations are maintained, and genetic connectivity restored by 2030, and at least 99% of genetic diversity among and within populations of species is maintained by 2050.</p>	<p>Our suggestion resolves numerous brackets. It makes clear that distinct populations must be maintained, and that within population genetic diversity is maintained by large effective sizes and genetic exchange. Progress can be measured by effective size $N_e > 500$ (Indicator A.5/A.0.4) and populations are maintained (Indicator A.8.1), as well as complementary indicators a.48 and a.51. We add the words ‘genetic connectivity’ (Frankham 2022).</p>
<p>Action Target 4. [Ensure active] ... management actions [to] [enable] ... the recovery and conservation of [threatened species] ..., [and] [to] [maintain and restore] the [genetic diversity] [within and between populations] of [all species] [[all] [native] wild and domesticated species]] [[to] [and] maintain their adaptive potential] including through in situ and ex situ conservation,</p>	<p>“Ensure active management actions to enable the recovery and conservation of species and to maintain, [manage, protect,] and restore the genetic diversity and adaptive potential within and among populations of species, and strategies for conserving genetic diversity are developed and initiated...</p>	<p>Our suggested text resolves numerous brackets. This wording specifies that active management actions to recover species must include action on genetically depleted populations and a goal of long term maintenance and protection of genetic diversity. It is connected to Indicators A.5/A.0.4, Indicator A.8.1, and a.48 (CBD/WG2020/3/INF/2).</p>

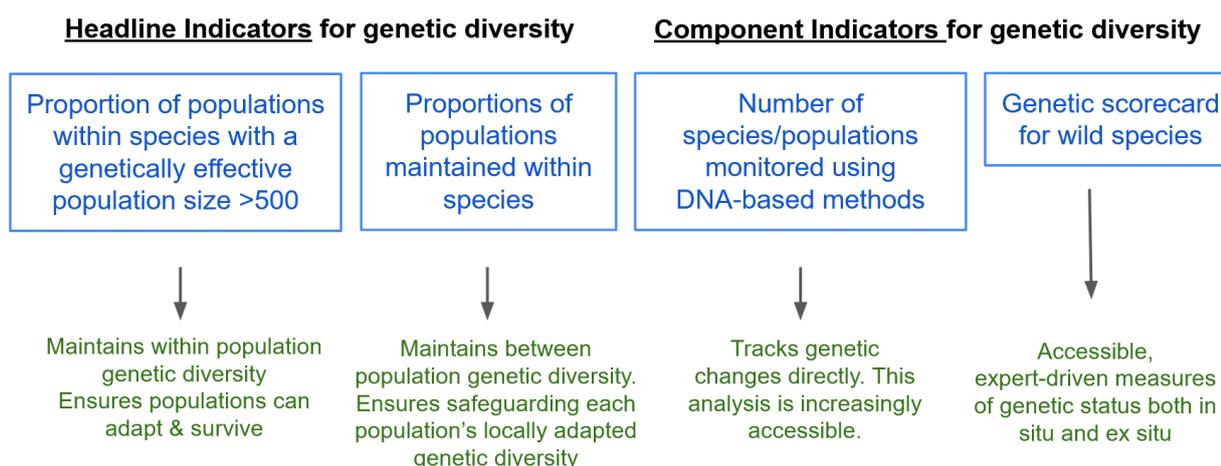
Target	Suggested text	Comments
Target 1 and 12	“Ecological connectivity” change to “ecological and genetic connectivity”	Gene flow (genetic exchange, genetic connectivity, connections among populations) is not mentioned yet. Maintaining genetic diversity will require appropriate levels of gene flow (which may necessitate restoring habitat connectivity or translocations).
Target 3	“Ecologically representative” protected areas; change to “ecologically and genetically representative”	Considering the distribution of genetic diversity across landscapes is important for creating protected areas that safeguard genetic diversity (Xuereb et al 2021).
Target 5 and 9	“Sustainable harvest” change to “demographically and genetically sustainable harvest”	We proposed that sustainable should mean demographic (the population size remains large and does not collapse) and genetic (no major shifts in genetic composition or in genetically based traits like size or behavior). Harvested populations have been highly impacted genetically (Pinsky and Palumbi 2014).

Indicators: Science-based, feasible, relevant, and measurable indicators exist to support this wording, are in the CBD monitoring framework and are supported by several Parties.

Table 2. Headline, Component and Complementary Indicators		
All indicators mentioned are measurable, quantitative, and ready for use		
Indicator	Suggestion	Comments
Headline Indicator A.5, previously A.0.4 “The proportion of populations within species with a genetically effective population size > 500”.	Retain as Headline Indicator	Maintaining populations’ effective size >500 will maintain 99% of genetic diversity at 2050, as in Goal A, and is appropriate for Target 4 on recovery actions for species and their genetic diversity, which has wide support (Frankham 2022). Ne 500 is the minimum recommended for helping population’s maintain adaptive potential. As noted above, relates to Targets 1, 4, 5, 9 and 12. This indicator is being compiled in nine countries as demonstrated in CBD webinars for viewing here and here . (Hoban et al 2021, Laikre et al 2021, Hoban et al 2022)

<p>Component indicator A.8.1 “The proportion of genetically distinct populations maintained within species.”</p>	<p>Move from Component to Headline Indicator</p>	<p>This indicator ensures maintaining genetic diversity among distinct populations. Loss of distinct populations will result in large losses of genetic diversity including loss of local adaptations. Among population and within population genetic diversity are both essential (Forester et al 2022). As noted above, relates to Targets 1, 3, 4, 5, 9 and 12.</p> <p>Can be compiled along with the Ne 500 indicator <u>with minimal additional effort- they have been developed in tandem.</u> (Hoban et al 2021, 2022, Laikre et al 2021, Thurfjell et al 2022).</p> <p>This indicator is being compiled in nine countries as demonstrated in CBD webinars for viewing here and here.</p>
<p>Complementary indicator a.48 “Genetic scorecard for wild species”</p>	<p>Move to Component indicator</p>	<p>A.48 should be elevated to a Component indicator as it has been successfully deployed at a country level (Scotland) and it is accessible to all signatory nations. Hollingsworth et al 2020, O’Brien et al 2022</p>
<p>PROPOSED indicator: monitoring using DNA methods “The number of populations and species in which genetic diversity is being monitored using DNA methods”</p>	<p>Add as Complementary indicator</p>	<p>Monitoring using DNA methods is feasible for many countries, and contributes to sound management of genetic diversity Hoban et al 2021, Andersson et al. 2022</p>

Figure 1. Proposed Genetic Diversity Indicators and Applications for Goal A and Target 4.



A webinar on this topic was presented recently by the Coalition and the CBD Secretariat, which you can view, along with other support materials [here](#). For questions, comments, contacts to experts, or for assistance in drafting genetic diversity language in interventions, please see a list of contact points and the languages they speak [here](#). Emails in languages other than English are welcome.

Frequently Asked Questions on genetic diversity

- 1. Question: Are the Goal and indicators SMART?**
Answer: Yes, the peer reviewed publication [Hoban et al 2021](#) Table 2 details how each metric is SMART- Specific, Measurable, Achievable, Relevant, and Time Bound
- 2. Q: Do genetic diversity Goals, Target 4, or indicators involve submitting or sharing Digital Sequence Information (DSI)?**
A: No. The first two genetic diversity indicators are counts of populations meeting a criteria (effective size threshold or being extant). Only the counts and proportions would be reported. *Parties do not submit DSI*. The indicator on counts of genetic diversity studies produced for conservation purposes (e.g. genetic studies of threatened species) is simply a count of studies, while the scorecard indicator is a summary of available knowledge, and *no DSI is shared*.
- 3. Q: Why are there multiple suggested headline indicators- maintaining an effective size (Ne) of A: 500 within populations, and maintaining all distinct populations?**
Genetic diversity *within* populations allows sufficient variation within each population to adapt to local conditions over time and to avoid inbreeding consequences. Genetic diversity *among* populations ensures the whole species can maintain enough adaptation for changing environments. *Both are essential for species survival* and for supporting resilient ecosystems. Maintaining one does not necessarily ensure maintaining the other.
- 4. Q: What does the phrase “genetically depleted populations are under restoration” mean?**
A: Genetically depleted populations have undergone substantial loss of genetic diversity but can often be rescued by translocating individuals from other populations (if available), active management to increase population size, habitat connectivity and other means. This may not fully restore genetic diversity but it can partially restore it and prevent further losses. Genetic diversity must also be protected.
- 5. Q: What does it mean to “ensure adaptive potential”?**
A: This means the facilitation/ management of conditions suitable to adaptive evolution: populations must be kept large, natural levels of connectivity maintained, and natural levels of reproduction occur.
- 6. Q: Do the indicators need to be done for all species, especially megadiverse countries?**
A: No, the indicators A.5/ A.0.4 and A.8.1 are calculated for approximately 100 representative species per country, as a proxy for all species, which allows disaggregation by taxonomic group or ecosystem as well. This is feasible with 2 to 2.5 months time for one person, perhaps less.
- 7. Q: How often can/ should the indicators be updated?**
A: Every four or five years which matches the time scale of environmental change and population change, and genetic processes (especially new offspring/ generations), and the timescale of CBD reporting.
- 8. Q: Do the two suggested headline indicators require using DNA-based techniques?**
A: No. Genetic data/ molecular techniques are not required. Indicators A.5 and A.8.1 can be reported using only census counts of individuals and field observations, which many national biodiversity programs have. When genetic data is available for some species, it can be used to directly measure effective population size (Ne), and/or to help define populations. (Even if it is used for these tasks, genetic data is not reported in reporting these indicators- again, DSI is not submitted in reporting.)
- 9. Q: Are there other useful indicators for genetic diversity?**
A: Complementary indicators a.51 (comprehensiveness of conservation of plant species ranges ex situ and in situ) and a.52 and a.53 (threatened breeds and genetic resources housed ex situ) are also useful complementary indicators that we endorse Further, the proposed complementary indicator “the number of species/populations monitored using DNA-based methods” (above) is useful and applied in some [countries](#).
- 10. Q: Is guidance in place to start applying the two suggested headline indicators, for reporting on Goal A and Target 4 on genetic diversity?**
A: Yes. Guidance on indicators A.5, A.8.1 and the proposed complementary indicator on genetic studies [has been published](#). Nine countries are compiling data for these indicators to demonstrate their use to other Parties. Supporting materials are being produced to support all countries in

reporting on these indicators in a reliable, robust manner. Training webinars and other outreach will occur throughout 2023 in multiple languages. Guidance on indicators a.48 and a.51 are available as well: [Hollingsworth et al 2020](#) and [Khoury et al 2019](#)

11. Q: Is any country using the genetic indicators now?

A: Several nations are committed to applying the genetic indicators and several are starting work to compile them and develop guidance documents for their use. [A recent effort in Sweden](#) assessed data availability for more than 20,000 species (20-30% had suitable data) and calculated the indicator for approximately 80 mammals, reptiles and amphibians. Meanwhile, the indicators are being deployed in South Africa, Mexico, Sweden, Belgium, France, Colombia, Japan and Australia, as explained in [a recent pre-print](#) (currently in peer review).

Table 3. Suggested Terms and Definitions for Addition to the CBD Glossary (CBD/WG202/4/2)	
Term/Concept	Definition/ explanation
Effective population size	A measure reflecting the maintenance of genetic diversity within populations. Usually N_e is approximately 1/10th of the census size (number of adult individuals, N_c). N_e below 500, or N_c 5000, will result in populations losing genetic diversity rapidly.
Genetic connectivity	A level of gene movement (movement of reproducing individuals, or in plants of pollen) between populations or subpopulations which helps to maintain genetic distinctions while also allowing adaptive genes to move among populations.
Genetic conservation strategies	Plans at national or regional level to ensure maintenance of genetic diversity.
Genetic diversity	Genome-wide diversity existing in the population (also known as “standing genetic variation”). Standing genetic variation is a major contributor to adaptive potential.
Adaptive potential	The ability of populations to evolve in response to environmental change, or the extent to which they can evolve. Adaptation occurs by changes in frequency of alleles that determine traits. Adaptive potential is a consequence of a large pool of genetic diversity and the size of the population. Typically, $N_e > 500$ is a minimum.
Safeguarded	To protect or make safe. In the context of biodiversity, to take actions to protect, including in situ protected areas, ex situ gene banks, and other activities. The actions are designed to minimize harm.
Maintained	To keep at the current state; prevent decline. Therefore, no loss occurs.
Effective population size (N_e)	A metric that measures the rate of loss of genetic diversity. N_e 500 (or N_e 1000, see Frankham 2022 , 2014) is a threshold value of this metric, below which genetic diversity loss increases exponentially (see Fig 2 in Willi et al 2022) - resulting in populations that do not maintain adaptive potential. N_e is often 1/10th the census size, thus N_e 500 corresponds to a census size of 5000 adult individuals.

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