How can biodiversity strategy and action plans incorporate genetic diversity and align with global commitments?

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ABSTRACT

National, subnational, and supranational entities are creating Biodiversity Strategy and Action Plans (BSAPs), to develop concrete commitments and actions to curb biodiversity loss, meet international obligations, and achieve a society in harmony with nature. In light of policymakers' increasing recognition of genetic diversity in species and ecosystem adaptation and resilience, this article provides an overview of how BSAPs can incorporate species' genetic diversity. We focus on three areas: Setting targets; Committing to actions, policies and programmes; and Monitoring and reporting. Drawing from 21 recent BSAPs, we provide examples of policies, knowledge, projects, capacity building, and more. We aim to enable and inspire specific and ambitious BSAPs and have put forward ten key suggestions mapped to "the policy cycle." Together, scientists and policy makers can translate high level commitments like the CBD into concrete nationally relevant targets, actions and policies, and monitoring and reporting mechanisms.

Keywords: (3-5): Convention on Biological Diversity, conservation genetics, policy, monitoring, implementation

MAIN TEXT

The Convention on Biological Diversity (CBD) is a multilateral treaty with 196 Parties (195 countries plus the European Union), in force since 1993, which commits to biodiversity conservation, sustainable use, and equitable sharing of benefits from utilization of genetic resources. In December 2022, Parties to the CBD adopted the Kunming-Montreal Global Biodiversity Framework (GBF), setting a roadmap for reversing biodiversity decline by 2030. As

127 a part of the GBF, each Party, including subnational and supranational entities, will update their
128 Biodiversity Strategies and Action Plans (SAPs) - documents that are used to assess, plan,
129 undertake, monitor and review actions to achieve the goals and targets agreed to under the CBD
130 (CBD/COP/DEC/15/6). National BSAPs (NBSAPs) allow Parties to articulate national level
131 biodiversity targets and their alignment to the Convention objectives, and other national planning
132 initiatives (e.g., South Africa's National Development Plan for 2030). Ideally, NBSAPs should
133 have high-level support from policy makers (e.g., legislators and country leaders) and be a
134 product of cross-ministerial cooperation (CBD 2022). They also offer an opportunity for co-
135 development with communities to foster broad societal ownership and investment in
136 biodiversity. Local and regional authorities are also developing supranational and subnational
137 biodiversity strategies (SBSAPS, https://www.cbd.int/nbsap/related-info/sbsap), such as in 26
138 Brazilian States and many Brazilian Municipalities (Ministério do Meio Ambiente 2017) and in
139 ASEAN (https://beta.aseanbiodiversity.org/action-plans/), as are businesses and Indigenous
140 groups.

141 Previous research showed that genetic diversity conservation had been neglected in
142 national reports and planning documents under the CBD (Laikre et al. 2010, Hoban et al. 2021b).
143 Genetic diversity underpins population and species persistence as well as species and ecosystem
144 diversity and is essential for nature's resilience in the face of pressures such as climate change
145 (Beger et al. 2014, Hoban et al. 2021a, Kardos et al. 2021, Shaffer et al. 2022). Conserving
146 genetic diversity also delivers social and economic benefits, sustainable resource use, stable food
147 supply, and mitigation of extreme events (Reusch et al. 2005, Hollingsworth et al. 2020, Stange
148 et al. 2021). In adopting the GBF, Parties committed to maintain, manage and restore genetic
149 diversity, focusing for the first time on all domesticated and wild species, in Goal A and Target 4

(see Figure 1). This is an expanded commitment from the previous 2011-2020 Strategic Plan, which focused on conserving genetic diversity in agricultural species, their wild relatives, and other species of socioeconomic importance.

Here, we present ten suggestions (Table 1) on how targets, strategies, policies, actions and reporting towards the conservation of genetic diversity can be articulated in BSAPs (although our primary goal is to inform Parties to the CBD regarding their NBSAPs, we use BSAP because the advice herein can inform strategies and actions at all levels- national, local, and regional). We aim to provide a general perspective to promote dialogue, inspiration, and starting points for drafting new BSAPs. We illustrate ideas with examples drawn from BSAPs obtained through the CBD's Clearing House Mechanism: all BSAPs published between January 2020 (release of the "zero draft" of the Global Biodiversity Framework) to February 2024 (Australia, Barbados, Cambodia, China, European Union [EU], France, Ireland, Japan, Republic of Korea, Serbia, Spain, Tunisia), plus earlier time periods to include geographic diversity and a wide range of viewpoints (Algeria, Argentina, Brazil, Colombia, Indonesia, Papua New Guinea, Uruguay), and unofficial draft documents from Sweden and SADC (Southern African Development Community). We include examples for both wild and domesticated populations and breeds, though we focus more on wild populations as there are efforts already to sustainably use, conserve in situ and ex situ, and monitor the diversity of breeds and varieties important to agriculture, forestry and aquaculture (e.g., FAO Commission on Genetic Resources for Food and Agriculture and International Treaty on Plant Genetic Resources for Food and Agriculture). The main sections of this paper are structured to follow three areas of CBD's guidance to Parties (CBD/COP/DEC/15/6): Section A: Setting national targets; Section B: Developing actions,

policies and programs to meet the targets, and noting finance and capacity needs; and Section C: Monitoring, review and assessment, including the use of indicators (Table 1).

Part A: Suggestions for setting national level targets

*Suggestion 1: Involve all stakeholders***.**

Foremost, BSAPs will be more likely to succeed and will deliver wider societal benefits if their development involves inclusive participation and takes a rights-based approach, in line with Section C of the GBF. As will be apparent from numerous examples in this paper, genetic diversity is a concern for managing ecosystems and species, as well as issues of human health, agriculture, livelihoods, and sustainability. Indonesia's BSAP (Government of Indonesia 2015) notes, "Erosion of sources of genetic diversity results in a serious threat to food security, shelter, and energy for the long term". Programs and agencies which currently focus on species and ecosystem diversity can both use and contribute to knowledge on managing genetic diversity (e.g., genetic data can help guide restoration or protected areas, see Suggestion 4; while knowledge from species monitoring can be used for genetic indicators, see Suggestion 8). As with other levels of biodiversity, numerous stakeholder groups hold diverse knowledge on genetic diversity and should be involved (see also Suggestion 4).

Suggestion 2: Set a national target on genetic diversity conservation within all species - native, wild and domesticated - which is aligned with (containing the same components and ambition as) the global target.

Genetic diversity is one of three components of biodiversity in Article 2 of the Convention text ("Biological diversity […] includes diversity within species, between species

and of ecosystems," CBD 1992). A target specifically on genetic diversity of all species, including both wild and domesticated (terrestrial and aquatic), can help address adaptive potential, population size, inbreeding, and other processes that ultimately help to conserve genetic diversity within and between populations, as well as species and ecosystem diversity. As noted in Japan's BSAP (Government of Japan 2023), "A decline in genetic diversity will threaten the persistence of species... Genetic diversity may be declining not only in rare species with small populations, but also in species with fragmented habitats and shrinking population sizes." Papua New Guinea's BSAP (Government of Papua New Guinea 2019) emphasizes the importance of maintaining "evolutionary processes."

For countries that use regional or sub-regional coordination to meet shared goals and targets, national targets may be designed or presented in light of regional targets or based on regionally negotiated frameworks. For example, SADC (SADC 2024) has a target to "Develop and execute comprehensive conservation strategies by 2035 to effectively mitigate the genetic erosion of biological resources, emphasizing the sustainable management of plant and animal genetic diversity, promotion of resilient agricultural practices, and establishment of seed banks or genetic repositories." Meanwhile, the Pacific Islands Framework for Nature Conservation and Protected Areas 2021–2025 (SPREP 2021) has an objective to "Protect and recover threatened species and preserve genetic diversity," and states that "Connections among protected areas are essential for their survival, to maintain genetic diversity and 'restock' populations after a disaster, such as a bleaching or disease event." Individual countries can adopt such targets and go beyond by specifying (sub-) targets, local context, higher ambition, and/or how they can be applied to wild and domesticated species.

We see room for improvement in some national genetic diversity targets, for example from Sweden and China: (SEPA 2024) “The adaptability of species is strengthened by preserving and enhancing genetic diversity” and (Government of China 2024) “maintain and restore genetic diversity of local, wild and domesticated species.” We suggest these examples could be better aligned with the global target (GBF Target 4), such as specifically committing to maintain, restore, conserve in situ and ex situ, and sustainably manage within and between population genetic diversity (see Figure 1). These specific components of the GBF are noted in several BSAPs, such as in Serbia (Government of Serbia 2021), where “populations require particular attention from the aspect of conservation, since they contribute significantly to the total genetic diversity of these species.” Argentina’s BSAP (Government of Argentina 2017) states a need for, “the conservation of genetic variability, which is crucial for the demographic viability of sub-populations, and their connectivity and distribution throughout Argentina's ecoregions and subregions.” Furthermore, Ireland’s BSAP notes: "Genetic diversity is important because it gives a better chance of survival in the face of environmental change. The breakup and loss of habitats can reduce genetic diversity by creating smaller, inbreeding populations. These populations then struggle to adapt to environmental changes such as drought."

Suggestion 3: If possible, set national targets that are more ambitious and specific, including means of achievement.

Higher ambition in genetic diversity conservation and management can help countries benefit from nature’s contributions to people and diverse natural resources. An analysis of the wording of GBF Target 4 (Hoban et al. 2020, 2023a) recommended that a target include policies and strategies (in addition to management actions), such as: “Develop and initiate national-level

policies and strategies, and take urgent management action, to 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, and develop and initiate national-level strategies and resources for conserving genetic diversity." Policies could focus on legal protection (e.g., of local breeds or of distinct populations) or strategic investment of resources (e.g., funding genetic monitoring programs, habitat restoration or ex situ collections/management/genebanks). Genetic conservation strategies and planning can define priority species for genetic monitoring, incorporate genetic diversity into spatial planning (including landscape connectivity), set timelines for capacity building, and prepare comprehensive reports on progress toward conserving genetic diversity (Posledovich et al. 2021). Of course, Parties may find other ways to make their national targets more ambitious or specific, such as providing emphasis on genetic connectivity or including expected outcomes. Parties may wish to specify which aspects of their national target(s) on genetic diversity can be achieved with existing resources and where more resources are needed.

Suggestion 4: When possible, note the relevance of genetic diversity for achieving other global and national targets.

By identifying linkages to genetic diversity throughout their BSAPs, Parties can underline the coherence of policies across sectors, and optimize monitoring programs. Genetic diversity monitoring and indicators can serve multiple reporting needs, and therefore alleviate the reporting burden on Parties (a recurrent issue). Genetic diversity is vital for meeting various targets, including Targets 2, 3, 4, 6, 8, 9, 10, 11, 13 (Hoban et al. 2020, 2021b, 2023a, Bolam et

al. 2023). These targets relate to topics such as: restoring degraded ecosystems, conserving and managing terrestrial and aquatic areas, management actions for recovering species and conserving genetic diversity, addressing the impacts of invasive species, minimizing impacts of climate change on biodiversity, sustainable management and use of wild species, enhancing sustainability in fisheries, forestry and agriculture, restoring and sustaining ecosystem services, and increasing the sharing of benefits from genetic resources and traditional knowledge (note these are simplified and not meant to embody the full targets' intent; the full text of targets can be found at https://www.cbd.int/gbf/targets). Highlighting such interlinkages can strengthen commitments to biodiversity at all levels.

For example, when relating to a possible Swedish national target on restoration, SEPA (2024) states "In… implementation of the framework, it is important to take into account ecological representativeness and connectivity that contribute to genetic exchange between populations." and Serbia's NBSAP (Government of Serbia 2021) intends to "integrate ecological corridors, as part of identified Trans-European Nature Network to prevent genetic isolation, allow for species migration, and maintain and enhance vitality of ecosystems." Indonesia's BSAP (Government of Indonesia 2015) notes that protected areas serve to conserve both species and genetic diversity. Regarding genetic diversity and invasive species and sustainable agriculture and fisheries, Sweden (SEPA 2024) aims for the "Introduction of alien genotypes that are potentially harmful to biodiversity has been strongly limited until 2030" and that "sustainable fishing practices will include maintenance of genetic diversity and avoidance of strong selective harvest that alters species' genetic diversity," while Colombia's BSAP notes that at least 57 non-native marine species threaten to reduce genetic diversity.

Part B: Suggestions for developing concrete actions, policies and programmes to meet the goal and targets, and noting finance and capacity needs

Suggestion 5: Describe actions that are expected to help maintain and restore genetic diversity, tailored to each country's capacity.

Tangible actions to support genetic diversity include restoring lost habitat connectivity to facilitate gene flow, preventing the loss of distinct populations, documenting and preserving local breeds and varieties, and enabling population growth for small populations (e.g., halting poaching, removing invasive predators) to maintain evolutionary potential (Fady et al. 2016, Hohenlohe et al. 2021, Willi et al. 2022). If populations cannot achieve sufficient size on their own, intensive management can include ex situ breeding and release or translocation of individuals (Bolam et al. 2023). Actions should be both in situ and ex situ and include laws, funding, and management (Hoban et al. 2021b).

Example commitments include: "Promote augmentation programs by releasing individuals into existing populations to increase their size and genetic diversity" (Government of Cambodia 2016), "Rescue populations with risks of genetic loss or erosion" (Government of Uruguay 2016), "Special efforts to increase the effective population size of populations of native wildlife species with an effective population size below 500 have commenced by 2025" (SEPA 2024) and "All native wild species subpopulations or geographic distribution maintained or re-established to strengthen genetic diversity, if ecological and technical conditions exist" (SEPA 2024).

As a specific example, in marine conservation, cooperation between Indonesia and 14 other countries aims to increase local population sizes of depleted shark populations (https://www.reshark.org/), which can benefit genetic diversity maintenance. Of course,

augmentation and release should follow best practices, including weighing beneficial and adverse outcomes of translocations, and consider the balance of local adaptation and genetic erosion (Weeks et al. 2011, IUCN/SSC 2013). As explained in Japan's NBSAP (Government of Japan 2023), "Since there is a high possibility of genetic differentiation between native species naturally distributed in Japan and the same species distributed outside of Japan, there is concern that the introduction or artificial release… may cause hybridization." Meanwhile, the Brazilian National Fund for Benefit Sharing helps to conserve genetic heritage ex situ (Government of Brazil 2018). Numerous countries commit to the important task of identifying and conserving genetic resources, such as local breeds and varieties, and to building or enhancing genebanks or biobanks. We note that "genetic diversity" and "genetic resources" have different meanings and should not be used interchangeably (Box 1).

Suggestion 6: Outline specific policy mechanisms and programmes that will facilitate positive action for genetic diversity.

We distinguish policies and programmes (as opposed to actions) as being at a higher level than on the ground actions, such as designation of protected status for distinct populations or breeds and their evolutionary adaptations (as in several national endangered species laws), or increased funding in the form of grants for local and regional authorities in charge of wildlife and habitat management. Although China (Government of China 2024) commits to "Conservation and Recovery of rare and endangered species and very small populations [and preventing] changes in genetic diversity," and Barbados (Government of Barbados 2021) states that marine protected area planning (e.g., spatial planning) should "ensure their long-term viability and to maintain biological and genetic biodiversity", BSAPs would ideally describe specific agency

policies, programs, and/or funding mechanisms. The United States (not a Party to the CBD) proposed a law (Restoring America's Wildlife Act, Bill S.1149) that would provide funding to fully implement management plans to help threatened species. The authority for implementation would be State wildlife and forest management agencies. Another example is Ireland's BSAP (Government of Ireland 2024), which aims to increase opportunities under agriculture, rural development, forestry, and other relevant policies to benefit biodiversity by 2027. The plan commits the National Parks and Wildlife Service and Department of Agriculture, Food and the Marine to implementation including by supporting "Farming for Nature initiatives that specifically enhance ecological connectivity." Meanwhile China's State Forestry Administration and the National Development and Reform Commission has initiated a program to restore Plant Species with Extremely Small Populations (Yang et al. 2020), and Uruguay (Government of Uruguay 2016) aims to "Promote scientific production and valuation of genetic resources." Papua New Guinea's BSAP (Government of Papua New Guinea 2019) suggests that the Forestry and Fisheries Policies could have a greater "emphasis on genetic and biodiversity conservation."

As another example, Parties may wish to establish a genetic conservation unit programme (GCU; Minter et al. 2021). GCUs are designated land or aquatic areas that maintain viable and evolving populations in situ, to support future adaptation. Designating and tracking GCUs involves identifying populations or portions of populations that are of sufficient size and contain important or unique genetic diversity. A database of GCUs can help to ensure sufficient genetic diversity is maintained, focus monitoring efforts and allow quick identification of source material for restoration. The European Forest Genetics program tracks nearly 4000 GCUs across Europe for >100 species in 35 countries (Lefèvre et al. 2020). GCUs can help to serve the needs of commercial forest management or other species harvest. GCUs are not limited to forest trees

and could be applied to many plants and animals and possibly fungi (Minter et al. 2021). Existing protected and managed areas may already function as GCUs for some species groups, highlighting mutual achievement of Targets 3 and 4.

Another option is to create national native plant or seed strategies or indicate participation in the sub-regional or regional equivalent (e.g., Pacific Community's Centre for Pacific Crop and Trees genebank). Such strategies help to ensure that restoration of habitat will include genetically diverse and genetically appropriate plant material (Gaisberger et al. 2024). Ideally, such strategies and actions will address both wild and domesticated species. Because producing such material relies on a chain of infrastructure and logistics, a national strategy must focus on the full cycle of restoration needs (planning seed collection, sufficient farms to grow native seed, facilities for storing seed, nurseries, education, expertise to inform planting in the right place with the right care) (Basey et al. 2015, Di Sacco et al. 2021). The French BSAP notes that the "Végétal local" brand helps ensure preservation of genetic diversity by guaranteeing wild origin and not using artificial selection, while maintaining forest genetic diversity supports resilience. Serbia's BSAP notes that the Trans European Nature Network (Fornarini et al. 2023), a set of ecological corridors, could help facilitate gene dispersal; IUCN guidelines on connectivity also mention that an ecological network should quantify the impact on genetic diversity (Hilty et al. 2020). In Spain the Royal Decree 159/2022 (Government of Spain 2022), established the National Bank of Forest Germplasm and Wild Flora "to effectively conserve the material of forest species, … ensuring their availability and addressing the conservation and reintroduction needs."

Other plans might include promoting the use of locally sourced native plant species in restoration projects and implementing habitat restoration that prioritize conservation of genetic

diversity (Hilty et al. 2020). In Japan, it is noted that there exists "Technical Guidelines for Reducing the Risk of Impacts on Genetic Diversity Related to the Release of [captive bred] Juvenile Fish." Forestry, fisheries, agriculture and wildlife management agencies could be named as being responsible for creating such guidance. Meanwhile, genetic diversity of crop wild relatives can help innovative, sustainable agriculture. In Argentina, transitioning to multifunctional landscapes within large-scale farming systems holds significant potential for enhancing biodiversity and promoting landscape connectivity (Garibaldi et al. 2023). In Brazil, amongst the 10 countries with the highest numbers of plant genetic resources stored in long-term facilities, a national plan for keeping plant genetic resources was established with a physical structure to house 700,000 accesses (Ministry of the Environment 2023), while Tunisia (Government of Tunisia 2019) aims to develop "system for the protection of traditional knowledge related to genetic resources," and to "Update and implement the conservation and valorization strategy of local agricultural genetic resources."

Suggestion 7- Identify current capacity, capacity and financing gaps, and capacity building plans regarding genetic diversity.

Capacity may include resources within the country to monitor and report on genetic diversity, to implement actions that support genetic diversity, or general training or expertise, which will vary among Parties (see Box 2). For example, ecological restoration has sometimes neglected genetic diversity concerns, resulting in the establishment of sites with low genetic diversity, decreasing adaptive potential of populations, high inbreeding, and diminished survival and productivity. Updating management practices to include genetic diversity will require training and collaboration between geneticists and practitioners. Calculating genetic indicators

401 for wild populations, which are fairly new, may also require training. We emphasize that
402 identifying barriers to implementation should not preclude inclusion of genetic diversity in
403 BSAPs. Indeed, recognising barriers can inform where capacity building is needed and facilitate
404 linkages among Parties and with organizations providing support.
405 Training programs tailored to stakeholders are essential for raising awareness about the
406 significance of genetic diversity and for building knowledge of relevant national and
407 international regulations. Educational initiatives play a crucial role in providing the knowledge,
408 skills, and confidence needed to make informed decisions about conserving genetic diversity.
409 Additionally, training programs in genetic diversity can empower decision makers to initiate
410 actions, effectively allocate resources, and advocate for impactful conservation measures. By
411 fostering a culture of innovation, collaboration, and inclusivity, these educational efforts
412 cultivate a new generation of leaders capable of driving positive change in biodiversity
413 conservation. For example, in Argentina, the educational modules established under the 'Yolanda
414 Law' (Law No. 27,592, passed in November 2020) require environmental training for all public
415 service employees - a crucial starting point for enhancing capacity, awareness, and collaboration
416 to fulfill the nation's biodiversity commitments. Argentina's BSAP (Government of Argentina
417 2017) also emphasizes training for companies regarding understanding of genetic resources.
418 Similarly, the SADC (SADC 2024) commits to "Develop and implement programmes for
419 Member States to empower local communities to actively participate in monitoring and
420 addressing genetic erosion in their region". Additionally, in Brazil, public service employees
421 responsible for proposing, implementing, and managing nationwide conservation policies are
422 being trained on DNA-based methods for monitoring and conserving genetic biodiversity, and
423 participating in the consortium "Genomics of the Brazilian Biodiversity". Similarly, in its 5th

National Report, Algeria commits to revise university training and education to better meet the needs of biodiversity management including specifically noting new techniques in genetic diversity conservation (People's Democratic Republic of Algeria 2014).

Such training can build on and coordinate with a wealth of prior capacity around genetic resources for food and agriculture. National Focal Points for plant, animal, forest and aquatic genetic resources within countries have experience monitoring, preparing country reports, coordinating implementation, etc. They are often supported by dedicated experts and practitioners. In addition, the Domestic Animal Diversity Information System (https://www.fao.org/dad-is/en/) already monitors population sizes of domesticated animal breeds, and their expertise in gathering, storing and presenting data would be valuable for reporting on indicators for genetic diversity of wild populations. Numerous guidance and tools are available at the FAO Biodiversity Knowledge Hub (https://www.fao.org/biodiversity/knowledge-hub/en).

Part C: Suggestions for monitoring systems, reviewing and assessment, including the use of indicators

Suggestion 8- Describe monitoring, evaluation and review of genetic diversity, including choice of appropriate indicators and, if possible, a list of local, national, and regional monitoring programs and available datasets that might be used to calculate genetic diversity indicators.

Several indicators of genetic diversity are contained in the GBF. The Headline indicator on proportion of populations (or breeds) with an effective size greater than 500 and the Complementary Indicator on proportion of populations maintained allow for the quantitative

447 assessment of genetic diversity status within and among populations, respectively (Hoban et al.
448 2020, Mastretta-Yanes et al. 2023). Australia's BSAP (Government of Australia 2021) alludes to
449 both of these with the text, "Species will need to maintain large, genetically diverse populations
450 to adapt… This fundamental requirement is challenged by other pressures reducing population
451 size (e.g., invasive species, habitat loss) or connectivity of suitable habitat (habitat
452 fragmentation)," and in-progress measures of "number of populations of threatened or near
453 threatened species… in government managed reserves [and]... protected by private landowners
454 through stewardship or other arrangements." These indicators are ready for use, leverage diverse
455 data, and are inclusive and fairly rapid (Hoban et al 2024).

456 Another indicator, the genetic scorecard (Hollingsworth et al. 2020) provides an
457 assessment of genetic status, synthesizing various genetic processes and actions for genetic
458 conservation in a way that is accessible to help land managers, policy makers and other
459 stakeholders effectively steward and allocate resources at a local, landscape or national scale. An
460 indicator for monitoring genetic diversity of crop wild relatives uses geographic proxies to
461 identify the protection level of in situ and ex situ populations (Khoury et al. 2019). Regarding
462 domesticated species, indicators exist to track the proportion of local breeds which are threatened
463 and the number and diversity of accessions in medium to long-term storage facilities
464 (CBD/COP/15/5). All of these can be compiled without any DNA-based data, using existing data
465 and knowledge.

466 To facilitate planning for reporting indicators, it will be valuable to make a list of local,
467 national, and regional monitoring programs and available datasets that could contain the data
468 needed to calculate genetic diversity indicators. The indicators for monitoring genetic diversity
469 currently in the GBF do not require DNA-based data, and can therefore leverage conventional

monitoring such as counts of individuals or spatial surveys of populations as well as qualitative knowledge (Hoban et al. 2023b, 2024). The BSAP could present a list of relevant programs and sources of information on counts of populations and occurrences over time (and/ or links to existing datasets and databases). This may include existing national, state or regional population surveys or inventories, volunteer or citizen science-based programs, community-based monitoring, and monitoring habitat area using remote sensing. National examples include the United Kingdom's National Forest Inventory and the Republic of Korea's National Ecosystem Survey, or national and transnational programs to monitor large mammals like moose, caribou, bears, lion and jaguar. These two examples are systematic national-level surveys across many species, but many other species are monitored by state or other authorities and small NGOs. Globally, the FAO Commission on Genetic Resources for Food and Agriculture monitors the state of the world's genetic resources for food and agriculture.

Suggestion 9- Producing a plan for indicator calculation and reporting, including what agencies will be involved, what are the data sources and data storage mechanisms, and what are realistic timelines for gathering data.

This is vital to ensure that personnel and resources are allocated, that logistics are in place and that there is accountability and a chain of reporting. In Ireland's report (Government of Ireland 2024), genetic diversity is partly assigned to the National Parks and Wildlife Service and the Department of Agriculture, Food and the Marine. In the Republic of Korea's report (Republic of Korea 2019), several agencies are named as responsible for reporting on genetic diversity, including the Ministry of Science and ICT, the Ministry of Health and Welfare, the Ministry of Environment, the Ministry of Oceans and Fisheries, the Rural Development Administration and

493 the Korea Forest Service, reflecting the GBF aim to mainstream biodiversity across society. Of
494 course, having too many agencies involved could have downsides (e.g., fragmented
495 responsibilities and implementation), and clear responsibilities for each agency would be
496 beneficial. When numerous agencies are involved, efforts are needed to ensure interoperability of
497 data and information collected and archived. Parties needing help reporting genetic diversity
498 indicators can find help from in-country biodiversity researchers as well as bodies that are being
499 set up to support GBF implementation (CBD/COP/DEC/15/8, see also Supplementary Document
500 2).

501 As noted in Box 2, non-governmental organizations, farmer or landowner groups, and
502 Indigenous Peoples (IPs) and Local Communities (LCs) are important partners in indicator
503 reporting. Brazil's BSAP commits to "Conserve the genetic diversity of local traditional or
504 crioula varieties locally adapted by indigenous peoples, traditional communities and family rural
505 producers." Collaboration can also be employed across different targets to promote synergy with
506 GBF reporting and facilitate methodological coordination and data and knowledge sharing. A
507 genetic diversity indicator pilot in Colombia materialized this in two ways, which optimized
508 biodiversity assessment. First, workflows and outcomes from different initiatives that could
509 provide information relevant to genetic diversity indicators were coordinated, such as Red List
510 assessments, protected areas management plans, systematic data collection, and systematic
511 expert consultation initiatives (Velásquez-Tibatá et al. 2019). Estimation of the indicators
512 provided data on the genetic diversity status of evaluated species, as input for their management
513 and conservation, and could lead to the prioritization of populations for monitoring using DNA
514 data (Hoban et al. 2023b). Genetic diversity indicators are being implemented in other initiatives
515 such as the Multidimensional Biodiversity Index (Soto-Navarro et al. 2021). Second, through the

Key Biodiversity Areas (KBAs) initiative, which identifies sites that contribute significantly to the global persistence of biodiversity based on the representation of species' populations (e.g., abundance, conservation status, distinctness), workshops were held to assess historical and current species distribution data - data necessary for both KBAs and genetic indicators. Genetic assessments also helped define population boundaries and determine the distinctiveness of an area. This collaborative effort illustrates how genetic diversity indicators can strengthen other biodiversity monitoring systems.

Suggestion 10- Review relevant existing national, regional and global reports and summarize the current state of knowledge, monitoring and action on genetic diversity to inform audiences such as policy makers and the public.

Reviewing what is known about genetic diversity in wild and domesticated species in-country can be a valuable comparison for the aforementioned plans. If in-country knowledge and capacity is insufficient, this should be noted as a capacity need. Scotland produced a report on 26 nationally important species using simple proxies that are understandable by the public and policy makers (Hollingsworth et al. 2020). Recently, Pearman et al. (2024) counted the number of multi-year DNA monitoring programs in 38 European countries. Additional reports can focus on particular sectors or groups such as forestry, fisheries, crop wild relatives, or game species, or particularly threatened species. Existing global and national reports on genetic diversity in forests or in food and agriculture provide useful models (FAO 2007, 2011, Black-Samuelsson et al. 2020). Reporting could assess the current capacity for DNA-based monitoring (e.g., reporting the number of government and academic labs with genetic equipment, number of university training programs in conservation genetics), and count the number of species that have had

539 DNA-based studies performed or species in which DNA-based methods are supporting
540 management and recovery. A Swedish model of such a report, co-drafted by researchers and the
541 Swedish Environmental Protection Agency, counted the number of species being genetically
542 monitored and summarized current genetic technology and capacity (Posledovich et al. 2021).
543 Several BSAPs note that systematic and ongoing analysis of genetic diversity at a landscape
544 scale will facilitate the achievement of the targets proposed (of numerous countries, including
545 Spain, the Republic of Korea, and Ireland), including those related to enhancing ecological
546 connectivity. Countries can also commit to reviewing relevant policies, plans and reports, such as
547 "Review plans and strategies that are in place to maintain the plant and animal genetic diversity
548 for food and agriculture and genetic diversity of other planted species in-situ and ex-situ."
549 (Government of Cambodia 2016). In addition, documenting and evaluating the success of past
550 policies and actions is critical to informing future practices and policies.

551 As previously noted, case studies are an effective way to translate genetic issues and
552 knowledge to non-geneticists. We recommend BSAPs summarize the findings of selected DNA-
553 based studies of species of interest and explain any DNA-based management actions. The use of
554 genetic sequencing is not necessarily limited to developed countries. The BSAP of Cambodia
555 (Government of Cambodia 2016) describes the use of DNA-based studies to distinguish hybrid
556 from non-hybrid individuals of Siamese crocodile (*Crocodylus siamensis),* and the use of non-
557 invasively collected (from feces) DNA samples to estimate the population size of elephants
558 (*Elephas maximus*) in the country. It also mentions "Development and strengthening of capacity
559 for using DNA-based methods for species identification and genetic diversity studies, and for
560 parentage, population structure and ecosystem health studies." Serbia notes that projects have
561 examined "genetic differentiation of populations in the Republic of Serbia is known for some

wild species… the horned viper (*Vipera ammodytes*) or green frogs (*Rana synklepton esculenta*), or of game/mammals, such as the roe deer (*Capreolus capreolus*)… brown trout (*Salmo trutta*), grayling (*Thymallus thymallus*).” Genetic data can also be used to study invasive species, as mentioned in the Barbados BSAP, regarding the introduced hare (*Lepus europaeus*). Parties could collaborate with genetic scientists to summarize results of high interest and to motivate further applications of conservation genetics in practice.

Bonus suggestion- If possible, commit to increasing genetic monitoring.

Some countries will be able to make concrete commitments to expand on existing monitoring of genetic diversity. The Swedish draft report (SEPA 2024) proposes that “The number of native wildlife species and populations that have been analyzed with genetic diversity has increased significantly and the monitoring of genetic diversity is carried out on an ongoing basis.”, while China’s commits to “explore surveys of the genetic diversity of wild organisms.” A number of examples are included in the Republic of Korea’s BSAP: “Carry out trial research to identify and monitor on a regular basis the genetic diversity of endangered species, endemic species and species with high economic value. Use the results… for management, listing/delisting of endangered species and selection of species to be introduced for recovery.” The Republic of Korea commits to specific goals: “202 cases analyzed as of 2018. 356 species will be analyzed from 2019 and 2026 (32 cases/year)” and “Evaluate regional adaptation characteristics through the development of high-density DNA markers… 5 species of tree, 90 markers (2017) → 15 species of tree, 450 markers (2022).” Another specific example is given under the Republic of Korea’s Target on sustainable agriculture, forestry and fisheries, as to monitor genetic diversity “Cultivate sea forests (3,000 ha per year) to recover coastal

ecosystems… and monitor their genetic diversity". Several countries commit to better documentation of local or regional landraces, breeds, or varieties using DNA-based and non-DNA based proxies.

Conclusion

We hope that this guidance provides Parties and other entities with a starting point, a checklist of possible considerations, and encouragement for including ambitious and specific targets, actions, policies and monitoring for genetic diversity in their BSAPs. Parties may ask which of these suggestions are "most important". We connected our suggestions to the requirements of NBSAPs according to the GBF (Table 1), and with the possible exception of Suggestion 3 and 10, we anticipate that the guidance provided is all equally important, being fundamental to completing obligations to the CBD. For further inspiration, a more complete list of quotes from the examined BSAPs can be found in Supplementary Document 1, and a short list of online resources for integrating genetic diversity into policy and practice can be found in Supplementary Document 2. To envision putting a plan into place, a high-level picture is shown in Table 1, mapping the ten suggestions to the policy cycle. We close by noting that it is of course important to connect the BSAP to national reporting and implementation on the ground, so that commitments are not "left behind (Maney et al. 2024).

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Table Captions

Table 1. In order to include genetic diversity in BSAPs, the three parallel phases of policy and CBD Guidance (first and second column respectively) should be followed and ten steps considered.

Figure Captions

Figure 1. Wording of Goal A and Target 4 of the Kunming-Montreal Global Biodiversity Framework relevant to genetic diversity, with explanations of some key words and phrases relating to genetic diversity (bold with arrows).

Box Captions

Box 1. Differences between “genetic diversity” and “genetic resources”.

Box 2. Challenges and opportunities for some countries on including genetic diversity in BSAPs.

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Box 1. Differences between "genetic diversity" and "genetic resources"

Equitable sharing of the benefits of genetic resources is one of the objectives of the Convention, along with biodiversity conservation and sustainable use. It is important to note that "genetic resources" and "genetic diversity" are not synonymous, and that achieving Targets on genetic resources and genetic diversity will each need specific attention, policies, actions and reporting.

Genetic diversity is the amount of variation within species and their populations (or breeds), which can be observed in trait variation (examples: thermal tolerance, color, size, shape, phenology, mating calls) and which is based on DNA variation. Genetic diversity helps species adapt and avoid inbreeding depression. Maintaining genetic diversity means preventing the loss of genetic diversity and supporting conditions for adaptive change. Assessing and reporting on the genetic diversity of populations or breeds within species can include reporting effective population sizes, loss of populations, levels of neutral and adaptive diversity, levels of genetic structure, and of impacts of processes like hybridization and inbreeding (for both wild and domesticated species). It is not necessary to have DNA sequence data for this reporting, but such data does inform conservation and management action for genetic diversity. Sequence data can be summarized in forms which do not require publishing sensitive information (Hoban et al. 2024).

Genetic resources are "genetic material of actual or potential value… genetic material means any material of plant, animal, microbial or other origin containing functional units of heredity" (CBD, Article 2). The term is frequently used in BSAPs and National Reports in reference to domesticated species or their wild relatives - especially regarding breeds, landraces, and similar units - but it could apply to any species. Many BSAPs have commitments on genetic resources, such as conserving traditional varieties on farms and managing, cataloging, increasing and using samples in gene banks. Some BSAPs and

National Reports also report the numbers of species in a country with possible use in medicine or food, or numbers of wild relative species, when reporting on the status of genetic resources. We note that a metric of the number of species, while a summary of "genetic resources," is not a measure of genetic diversity within species.

Box 2. Challenges and opportunities for some countries on including genetic diversity in BSAPs

All BSAPs reviewed mention genetic diversity in some form, albeit to various extents (see Supplementary Document 1, Tables S1 & S2). For the majority of Parties yet to submit updated BSAPs, ambitious and clear targets and actions restoring and maintaining genetic diversity within wild and domesticated species should be feasible.

Still, we acknowledge challenges faced by countries with limited financial and technical resources. Management actions, enforcement of legislation, and monitoring of genetic diversity all require funds, personnel, and expertise. The GBF does commit to additional resourcing and capacity building and yet gaps remain. Technical capacity around genetic diversity may be lower in developing economies, which means that training, exchange visits, workshops, and published guidance are needed.

Monitoring and management needs are also higher in countries with higher numbers of species - more species need to be evaluated and more species will need active management interventions to improve their genetic diversity status (Ragamustari and Sukara 2019). Yet generally highest diversity falls within developing economies, where least resources are often available. Even the substantial budget allocation by SADC (20+ million USD) to address genetic diversity and genetic resources over 10 years across SADC countries, is < 140,000 USD per year per country (SADC 2024).

Large nations with numerous isolated or remote areas face challenges in the logistics of monitoring and in determining whether populations are isolated. For example, the sheer area and high biodiversity in countries like Brazil and Indonesia faces challenges for monitoring

populations, assessing their census sizes, or collecting samples for genetic analysis. Countries with populations of highly mobile marine species also face difficulties identifying populations; transboundary cooperation will be essential for assessing and monitoring genetic diversity of these populations. Marine organisms, invertebrates, fossorial organisms and other species which are hard to count may be challenging, though using a combination of emerging technologies, Red List experts and workshops, citizen science, and Earth observation data will be helpful in tackling these challenges.

Meanwhile there are opportunities to leverage community participation. In addition to establishing community seed banks to help preserve genetic lines, Indigenous Peoples (IPs) and local communities (LCs) often have knowledge on genetic diversity in the form of unique traits, behavior, or other within-species variation. IPs and LCs can sometimes contribute knowledge on the number of individuals within a species (and decrease in numbers or area occupied) or loss of a species from a local area, contributing to monitoring and reporting. The existing knowledge and the participation of IPs and LCs could help alleviate some of the monitoring challenges noted above (large numbers of species, limited financial and technical resources, large numbers of islands), while in all countries complementing other forms of knowing and monitoring biodiversity. Other stakeholders can also help. For example, local volunteers, farmers and foresters were able to design a successful conservation management plan for a European Protected Species of amphibian, the great crested newt (*Triturus cristatus*), that combined genetic evidence with local stakeholder knowledge (O'Brien et al. 2021). Involving diverse stakeholders is therefore important for successful conservation planning (see also the IUCN SSC Conservation Planning Specialist Group https://www.cpsg.org/)

Table 1. In order to include genetic diversity in BSAPs, the three parallel phases of policy and CBD Guidance (first and second column respectively) should be followed and ten steps considered.

Define agenda and impact, adopt policy	**Setting national targets**	**1**	**Involve all stakeholders:** The BSAP will be more likely to succeed and will deliver wider societal benefits if its development involves inclusive participation and takes a rights-based and whole-of-society approach, in line with Section C of the GBF.
		2	**Set a national target on genetic diversity conservation within all species which contains the same components and ambition as the global target:** An effective genetic diversity target will be aligned with the global target, which includes maintaining genetic diversity within and between populations of native, wild and domesticated species at sufficient levels for adaptive potential.
		3	**If possible, set national targets that are more ambitious and specific, including means of achievement:** Parties can make national targets more ambitious by increasing specificity and scope, and including target components on policy and planning, enabling countries to benefit from nature's contributions to people and diverse natural resources.
		4	**Whenever relevant, note the relevance of genetic diversity for achieving other global and national targets:** BSAPs can include crosswalks or connections of genetic diversity to other relevant biodiversity targets to identify synergies and make the best use of funds and resources for coordinated reporting (see text for example targets).
Implementation	**Concrete actions, policies, and programs to meet the goals and targets**	**5**	**Describe actions that are expected to help maintain and restore genetic diversity, tailored to each country's capacity:** BSAPs may describe and commit to actions that can help maintain and restore genetic diversity, such as supplementing populations, planning translocations, restoring habitat connectivity, and active management of threats.
		6	**Outline specific policy mechanisms and programmes that will facilitate positive action for genetic diversity.** Complementing the commitment to action, it is helpful to describe the policies, legal frameworks, and programs that promote, fund, or facilitate such actions (e.g. national seed strategies, sustainable management, legal protection of subspecies and populations).
		7	**Identify current capacity, capacity and financing gaps, and capacity building and long-term funding plans regarding genetic diversity:** Describing current and needed capacity regarding training, equipment, partnerships, etc. can help facilitate the capacity-building support services that are currently being set under the GBF and foster collaboration among Parties and sectors. A long-term commitment and plan for funding will ensure consistency and secure knowledge and expertise over time.
Evaluation, review, support	**Monitoring systems, reviewing and assessment**	**8**	**Describe monitoring, evaluation and review of genetic diversity, including choice of appropriate indicators, and available data.** It is useful to describe indicators for reporting genetic diversity for both wild and domesticated species, and the country's capacity to report indicators, such as by listing monitoring programs and available datasets (using DNA or using non-DNA based proxies (Hoban et al. 2024)) that might be used to calculate genetic diversity indicators.
		9	**Produce a plan for indicator calculation and reporting (agencies to be involved, data sources and data storage, and realistic timelines for gathering data):** A plan for reporting, including which agencies are responsible, can help ensure that the identified actions, commitments, and reporting will have ownership. Identifying and using synergies with plans for other targets or programs can help make use of limited resources.
		10	**Review the current state of knowledge, research and action on genetic diversity to inform audiences such as policy makers and the public:** A synopsis of the current state of DNA-based assessments, or other knowledge on genetic diversity, and commitments and/or case studies of DNA-based knowledge or the use of DNA to guide management can be presented, in collaboration with in-country experts.

Goal A: … the genetic diversity within populations of **wild and domesticated species**, is **maintained**, safeguarding their **adaptive potential**

No further loss

Higher genetic diversity increases the chance for species and populations to adapt to changing environments

All species, not just socio-economically and culturally valuable species (in contrast to Aichi target 13)

Take action to restore conditions for genetic diversity (e.g. population connectivity, population connectivity, supporting population recovery).

- **"within" population genetic diversity supports rapid adaptation to environmental change in each population and reduces inbreeding.**
- **"between" population genetic diversity safeguards the breadth of conditions across all populations, providing diverse options for long term species survival**

Target 4: … 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…

Supplementary Document 1 for

How can biodiversity strategy and action plans incorporate genetic diversity concerns, plans, policies, capacity, and commitments?

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To help illustrate the various recommendations put forward in our manuscript on how targets, strategies, policies, actions and reporting towards the conservation of genetic diversity can be articulated in BSAPs, we provided text taken from twenty-one BSAPs, be they regional or national, as examples of what can be incorporated and what could be improved. The examples provided were not exhaustive, and hence in this supplementary document we provide a more complete list of quotes/excerpts from the 21 examined BSAPs.

Table S1. Frequency of use of various genetic terms in the 21 national and regional Biodiversity Strategy and Action Plans reviewed for this manuscript.

	Number of times each term is used*			
Country	**genetic**	**genetic diversity**	**genetic erosion**	**genetic resources**
Argentina	99	8	1	54
Australia	3	2	1	1
Barbados	60	25	7	15
Brazil	106	3	0	3
Cambodia	157	39	2	93
China	74	7	0	61
Colombia	3	1	0	2
France	18	4	0	4
Indonesia	145	15	1	47
Ireland	29	8	0	11
Japan	95	2	0	54
Papua New Guinea	32	7	0	16
Republic of Korea	119	23	0	75
Serbia	106	25	2	60
Spain	13	1	0	11
Sweden	60	12	0	34
Tunisia	16	1	1	11
Uruguay	8	4	2	27
Region				
European Union	3	1	0	1
Southern African Development Community	172	23	12	112

*For NBSAPs not written in English, counts represent language specific translations of these terms.

Table S2. Additional examples of text (i.e., not noted in the main text) relating to the term 'genetic' present in the national and regional biodiversity and action plans reviewed in this manuscript.

Published on CBD Clearing House from 2020	
Australia	**Australia's Strategy for Nature 2019-2030** Of particular concern is that to survive accelerating climate change, species will need to maintain large, **genetically diverse populations** to adapt in place or move to more suitable habitats. This fundamental requirement is challenged by other pressures reducing population size (e.g. invasive species, habitat loss) or connectivity of suitable habitat (habitat fragmentation). The restoration and connection of habitats should aim to maximise the **genetic diversity** and complexity of restored ecosystems, requiring the maintenance of viable seed supplies. As a party to the Convention on Biological Diversity, Australia contributes to the global biodiversity framework, and its targets, to conserve and use biodiversity in a sustainable manner and share benefits arising from **genetic resources** in a fair and equitable way.
Barbados	**Barbados National Biodiversity Strategy & Action Plan 2020** **Submitted to CBD 1 December, 2021** The country is home to…. **genetically-signifcant populations** of species Ecosystem services are mentioned : ...**genetic resources** . and argued that germplasm conservation is critical for ensuring sustainable food security. Aligned with SDG Goal 15: promote fair and equitable sharing of the benefits arising from the utilisation of **genetic resources** and promote appropriate access to such resources, as internationally agreed National Target 10 for the 2030 strategy: By 2030, the **genetic diversity** of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is

maintained, and strategies have been developed and implemented for minimizing **genetic erosion** and safeguarding their **genetic diversity**

Strategic Actions for National Target 10 is:

1. establish a national programme to preserve germplasm for nationally important cultivated plants and farmed animals and any remaining wild relatives (e.g. Barbados Blackbelly sheep; West Indies Sea Island cotton).
2. Establish and maintain a national register of **genetically significant breeds**.
3. Through collaborative arrangements among the agencies responsible, develop and implement management strategies, including monitoring and evaluation, to safeguard the **genetic diversity** of these socio-economically and culturally important species.

Indicators for Target 10: Number of identified socioeconomically and culturally important species being actively protected. Number of significant breeds. Also mentioned that insufficient resources are available to register the significant breeds and make them electronically available.

In the Appendix the refer to the SPAW (SPecially PRotected Areas and Wildlife) protocol : "requires Parties to establish Protected Areas as necessary, to conserve, maintain and restore: a) coastal and marine ecosystems "to ensure their long-term viability and to maintain biological and **genetic biodiversit**y,"

Reporting on Aichi Targets:
Progress towards implementation of Aichi Target 13: Mapping of natural fibres and seeds used by the crafts sector (2015). Ministry of Agriculture, collaborating with national Barbados Natural Fibres Network (an NGO) to establish a seed bank for natural fibres and seeds in the first instance and then for crops of agricultural importance.

Indicators for Target 13 are: Trends in **genetic diversity** of cultivated plants and farmed and domesticated animals and their wild relatives. Trends in **genetic diversity** of selected species. Trends in number of effective policy mechanisms implemented to reduce **genetic erosion** and safeguard **genetic diversity-**related to plant and animal **genetic resources**.

Examples of species/populations that are in need of protection were provided:

	• the hare population may be differentiated from the ancestral European population and may have a reduced **genetic diversity**. Molecular DNA **genetic diversity**, morphological and physiological studies are currently being conducted in this regard. Makes note of other International conventions that are relevant to the protection of biodiversity, including SPAW ….to establish Protected Areas as necessary, to conserve, maintain and restore: a) coastal and marine ecosystems to ensure their long-term viability and to maintain biological and **genetic biodiversity**,
Cambodia	**Kingdom of Cambodia National Biodiversity and Action Plan February 2016** Promote augmentation programs by releasing individuals into existing populations to increase their size and **genetic diversity** Characterize and classify the **genetic diversity** of cultivated plants and their wild relatives for morphological and agronomic traits, including at the molecular level if possible. Review plans and strategies that are in place to maintain the plant and animal genetic diversity for food and agriculture and **genetic diversity** of other planted species in-situ and ex-situ Development and strengthening of capacity for using DNA based methods for species identification and **genetic diversity** studies, and for parentage, population structure and ecosystem health studies. In regards to conservation, **DNA** Sampling of 69 crocodiles in captivity to identify the pure Fish-eating Hill Crocodile (C. siamensis) crocodiles has had positive results: 34 Siamese, 32 Hybrid with Estuarine, and 3 Hybrid with Cuban. Fecal DNA studies of wild elephants have been used to estimate a population 400-600 elephants in Cambodia. The most positive trend is the innovative use of **DNA** for crocodile and elephant research, but need more research on commercial animals and wild relatives. Enhance the protection of the **genetic diversity** of cultivated plants and farmed and domesticated animals, as well as the **genetic diversity** of their wild

	relatives by ensuring their sustainable use through: the sustainable use of economically valuable local wild plants and animals, Fostering collaboration and coordination at the national, regional and international levels with universities and research institutions, and the Consultative Group of International Agricultural Research Centres for examples; strengthening the national clearing-house mechanism to handle data and information on plant **genetic resources** for food and agriculture, other plant **genetic diversity** and animal **genetic diversity**.
China	中国生物多样性保护战略与行动计划 （2023—2030 年) [China Biodiversity Conservation Strategy and Action Plan (2023-2030)] Submitted to CBD 25 January, 2024 Chapter 1, Biodiversity status ● China is one of the richest countries in the world in terms of biodiversity because of its vast area, land and sea, unique ecosystems, species and **genetic diversity**. ● **Genetic diversity**: China is one of the world's major centers of origin for crops, as well as one of the native places of crops such as rice, flax, eggplant, bananas, and oranges. It has been the earliest domestication and cultivation of crops such as soybeans, millet, plums, peaches, and apricots. According to incomplete statistics, China has 1,339 cultivated crop species and 455 types of cultivated crop wild relatives. It has 12,807 types of traditional Chinese medicine resources, of which over 3,500 medicinal plants are unique to China. There are more than 1,000 economic tree species, and there are 7,000 species of original ornamental plants. China is a significant center for livestock and poultry **genetic resources** and domestication. A total of 948 local breeds, cultivated breeds, and introduced breeds of livestock and poultry are included in the National Livestock and Poultry Genetic Resources List. Chapter 2, Threats to biodiversity: ● Similar to the factors threatening global biodiversity, biodiversity in China is also adversely affected by factors such as natural habitat loss and destruction, excessive exploitation of natural resources, environmental pollution, invasion of alien species, and climate change, resulting in varying degrees of degradation or loss of ecosystem, species, and **genetic diversity**.

Chapter 4, Priority Areas and Actions for Biodiversity Conservation:

- A relatively complete system for the reception and rescue of wild animals has been established, with strengthened construction of breeding bases for rare and endangered species, orderly implementation of reintroduction programs, and establishment of a national gene bank for wildlife. Efforts have been intensified in the relocation and ex situ conservation of national biological **genetic resources**, with a focus on collection and conservation of **genetic resources** of wild organisms, comprehensive advancement in the collection and preservation of germplasm resources such as crops, livestock and poultry, forestry and grass, Chinese medicinal materials, marine, and freshwater fisheries, significantly increasing the total amount of preserved resources. Scientific construction of relocation protection communities for rare and endangered animals and plants has been carried out to maintain and restore **genetic diversity** of local, wild, and domesticated species. Implementation of protection action plans for seven species including the Chinese white dolphin and Chinese sturgeon has been further enhanced to strengthen the conservation of aquatic wildlife. Strict management of zoos, oceanariums, and various wildlife breeding sites, standardizing commercial activities such as exhibitions and performances. By 2030, a relatively complete relocation protection system for rare and endangered wildlife will be formed.
- Priority Action 10: Translocation Conservation of Biodiversity Steadily promote the construction of the national botanical garden system and establish a translocation conservation system for wild plants consisting of national botanical gardens, botanical gardens, research centers for propagation and translocation conservation, and germplasm resource repositories. Form a relatively complete system for the reception and rescue of wild animals, strengthen the construction of breeding bases for rare and endangered species, carry out orderly releases into the wild, and establish a national genetic resource gene bank for wild animals. Strengthen national translocation and in vitro conservation of biological **genetic resources**, strengthen the collection and conservation of wild biological **genetic resources**, comprehensively promote the collection and preservation of germplasm resources such as crops, livestock and poultry, forestry, Chinese medicinal materials, marine and freshwater fisheries, etc., and greatly increase the total amount of resource preservation. Scientifically construct translocated protection communities for rare and endangered plants and animals, maintain and

restore the **genetic diversity** of local, wild, and domesticated species. Thoroughly implement protection action plans for 7 species such as the Chinese white dolphin and Chinese sturgeon, and strengthen the protection of aquatic wild animals. Strictly manage zoos, oceanariums, and various types of wild animal breeding and breeding places, and regulate commercial activities such as exhibitions and performances. By 2030, a relatively complete translocation protection system for rare and endangered wild plants and animals will be formed. Column 10 Priority Projects for Biodiversity Translocation Conservation 1. Assessment of the status of translocation conservation of wild plants and animals Conduct various evaluations of the effectiveness of the construction of the translocation conservation system for wild plants and animals, grasp the status of translocation conservation of wild plants and animals and their return to the wild, and identify conservation gaps. Evaluate the contributions and problems of zoos, oceanariums, wild animal breeding and breeding places, and rescue and rescue institutions to the translocation conservation of wild animals, establish the species lineage and breeding files of translocated protection populations, and promote the formation of a relatively complete translocation protection system for wild plants and animals.

Biodiversity Survey and Monitoring

- Improve the technical standards system for biodiversity survey and monitoring, promote the standardization and standardization of survey and monitoring work. Coordinate various resource survey and monitoring work, strengthen the monitoring of ecological protection red lines, comprehensively promote the survey of priority areas for biodiversity conservation and key ecological areas of the Yellow River, key ecological areas of the Yangtze River, Beijing-Tianjin-Hebei, nearshore waters, and other key regions' ecosystems, key species, and important biological **genetic resources**. Fully rely on existing monitoring sites and sample sites (lines) at all levels to improve the biodiversity monitoring network, incorporate biodiversity into ecological quality monitoring, and enhance the biodiversity monitoring platform for nature reserves. Continue to carry out national key protection of wild animals, wild plant resource survey and monitoring, as well as 51 kinds of germplasm resource surveys including crops and livestock, aquaculture, forestry, medicinal plants, fungi, etc., and explore the survey of **genetic diversity** of wild organisms. Adjust and publish the list of nationally protected wild animals and plants in a

	timely manner, regularly update the list of biological species and biological **genetic resources,** and determine and publish the list of important habitats for wild animals. Integrate and establish a multi-party cooperative survey and monitoring system, fully mobilize social forces and capital to participate in survey and monitoring work. By 2030, it is basically achieved that regular surveys and routine monitoring of key regional ecosystems, key species, and important biological **genetic resources** are fully covered, and the level of biodiversity survey and monitoring is comprehensively improved. Priority Projects for Biodiversity Survey and Monitoring: ● 1: Survey of Biological Species Resources (including biological **genetic resources**). Research and analyze existing gaps in biodiversity surveys and conduct targeted surveys, focusing on inland waters, coastal zones, and marine biodiversity surveys, as well as surveys of higher plants, birds, mammals, amphibians and reptiles, insects, and other biological species, and explore the survey of **genetic diversity** of wild organisms. Continuously promote the survey of germplasm resources such as crops, livestock, aquaculture, forestry, medicinal plants, and fungi, and timely compile or update relevant lists based on survey results.
European Union	[EU Biodiversity Strategy for 2030 Bringing nature back into our lives] Submitted to CBD 14 November, 2023 …it will be important to set up ecological corridors to prevent **genetic isolation**… …the decline of **genetic diversity** must also be reversed, including by facilitating the use of traditional varieties of crops and breeds… ● Fostering collaboration and coordination at the national, regional and international levels with universities and research institutions, and the Consultative Group of International Agricultural Research Centres for examples; strengthening the national clearing-house mechanism to handle data and information on plant **genetic resources** for food and agriculture, other plant **genetic diversity** and animal **genetic diversity**... …fair and equitable sharing of benefits form the use of **genetic resources**…
France	Link to BSAP: https://www.cbd.int/doc/world/fr/fr-nbsap-v3-fr.pdf

Preserving and restoring the biological diversity of both metropolitan and overseas France - at the **genetic**, species and also ecosystemic levels of diversity- is a major contribution necessary to the achievement of international commitments on protection of Life.

Genetic impoverishment of animal populations → mentioned in an infographics as an impact to biodiversity due to transport/mobility needs of human activities

Nagoya protocol on **genetic resources**

Action 4 of the NBSAP: Objective: Strengthen control of trade and exploitation of wild species, **genetic resources** and products derived from deforestation through the creation of a dedicated national service. This action belongs to a broader target (Axe 1 - Mesure 4) aimed at reducing pressures affecting biodiversity by acting on country's commodities imports to reduce France's footprint on biodiversity of foreign countries.

the access to **genetic resources** and the fair and equitable sharing of benefits arising from their use

invest massively in research and innovation for the development and deployment of alternative non-chemical solutions (biocontrol, mechanics, technology, robotics, **genetics**)

Objective: Promote the diversification of crops and animal species and **genetic resources**

Actions in favor of the **genetic diversity** of crops and livestock will also be developed

Participation in european and international actions focused on the conservation and the sustainable use of **genetic resources** for agriculture and food will be continued: France's involvement in European exchange networks (EUFORGEN for forestry resources, ECPGR for plant **genetic resources**, ERFP for animal **genetics**), the FAO's Commission on Genetic Resources for Food and Agriculture and the International Treaty on Plant Genetic Resources for Food and Agriculture

	Preserve forest biodiversity and the **genetic diversity** of forest species, as a guarantee of resilience Promote the integration, in planting initiatives, of plants of the Végétal local brand, which guarantees their origin and their non-selection to optimize **genetic diversity** Mention to eDNA as a new and innovative monitoring technique Multiple mentions in this page to eDNA, which characterize **genetically** a species through the presence of short DNA sequences.
Ireland	**Ireland's 4th National Biodiversity Action Plan 2023–2030** Submitted to CBD 8 February, 2024 Genes: The **genetic diversity** of individuals within a species, or what makes one otter different from another otter Why do we need a National Biodiversity Action Plan? - The principle aims of the CBD are: … and the fair and equitable sharing of benefits arising from the use of **genetic resources** Objective Two Meet Urgent Conservation and Restoration Needs - This Objective contains actions to address freshwater, marine, agricultural and forestry challenges, as well as **genetic diversity** and invasive species. Many of these actions are embedded into existing policies across these sectors/thematic areas. This Objective also sets out actions for safeguarding the **genetic diversity** of wild populations and cultivated and domesticated species. Genetic diversity is important because it gives a better chance of survival in the face of environmental change. The breakup and loss of habitats can lower **genetic diversity** by creating smaller, inbreeding populations. These populations then struggle to adapt to environmental changes such as drought. Implementation of the CBD Nagoya Protocol and its associated EU Regulation will provide a strong basis for greater legal certainty and transparency for both providers and users of **genetic resources**. Outcome 2E: **Genetic diversity** of wild and domesticated species is safeguarded ● Target: Continue to support conservation and sustainable use of **genetic resources** in Ireland

    - Action: Promote the conservation and sustainable use of the **genetic resources** in Ireland through the work of the DAFM Genetic Resources Grant Aid
        - Indicator: Number and value of grant supported projects/ programmes
- Target: By 2030, work towards **genetically** characterising all native tree species to identify populations for conservation
    - Action: DAFM, National Botanical Gardens and other relevant organisations continue the work of the Forest Genetic Resources Working Group
        - Indicator: Number of tree species **genetically** characterised

- Target: By 2027, resources and capacity for national wildlife biobanking initiatives are increased to safeguard the **genetic** future of Ireland's wildlife
    - Action: Dublin Zoo will establish a national wildlife Biobanking Hub
        - Indicator: Number of species biobanked at the National Wildlife Biobanking Hub at Dublin Zoo

- Target: By 2027, national initiatives on biobanking for key species to support biological diversity are supported
    - Action: NPWS, DAFM and relevant departments and agencies will ensure that resources and capacity for national biobanking initiatives will be increased, working with existing partners such as Dublin Zoo to safeguard the **genetic f**uture of key species
        - Indicator: Number of biobanking initiatives supported

- Target: By 2030, the number of species, varieties and landraces for which conservation measures are being undertaken is significantly increased.
    - Action: Number of species, varieties, or landraces for which conservation measures are being undertaken By 2027, Ireland is making progress on the National Strategy for Plant Conservation 2E6 The National Botanic GardenBy 2024, an operational framework for the implementation of the Nagoya Protocol will be in place 2E8 NPWS will put in place an operational framework to facilitate implementation in conjunction with other

stakeholders/competent authorities across sectors and other Government agencies NPWS Operational framework in place

- Target: By 2027, Irish seed banks are collaborating to maintain a collection of seeds from all plants native to Ireland
    - Action: The National Botanic Gardens Wild Flora Seed Bank will collaborate with other seed banks such as the Threatened Seed Bank in Trinity College Dublin, the Crop Wild Relative, Cereal and Potato Seed Bank in DAFM the Apples and Vegetable Seed Bank held by the Irish Seed Savers Association and the Grassland and Clover Seed Bank held by Teagasc to ensure maintenance of a full collection of seeds from all plants native to Ireland
        - Indicator: Number of seeds collected, processed and accessioned in the seed bank.

- Target: By 2024, an operational framework for the implementation of the Nagoya Protocol will be in place
    - Action: NPWS will put in place an operational framework to facilitate implementation in conjunction with other stakeholders/competent authorities across sectors and other Government agencies
        - Indicator: Operational framework in place

Target: By 2030, the NMI will expand the available **genetic** samples of Irish cetaceans donated by citizen scientists and continue to make them available for research

- Action number: 4B5 Repository of and access to **genetic** samples of Irish cetaceans will be available for research
- Action: NMI will expand the infrastructure for housing the Irish Cetacean **Genetic** Tissue Bank, and continue to provide sampling kits and training in their use to citizen scientists D
- Indicator: distribution of sampling kits to citizen scientists (estimate over 1,000)

GBF target : TARGET 4 [wording from GBF, not Ireland-specific]- Ensure urgent management actions to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk, as well as to 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, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence.

Contribution of NBAP, or other relevant Government policy, to the Global Biodiversity Targets - NBAP actions specify the implementation of conservation measures necessary to achieve the conservation objectives for Natura 2000 sites and the implementation of Species Action or Threat Response Plans. This includes setting population targets for threatened and endangered species that are in Unfavourable status or have declining trends, support for species conservation programmes, support for ex situ conservation including seed banks and biobanks. A National Restoration Plan will also include actions to safeguard habitat for species.

GBF target 13 - Take effective legal, policy, administrative and capacity-building measures at all levels, as appropriate, to ensure the fair and equitable sharing of benefits that arise from the utilization of g**enetic resources** and from digital sequence information on **genetic resources**, as well as traditional knowledge associated with **genetic resources**, and facilitating appropriate access to **genetic resources**, and by 2030, facilitating a significant increase of the benefits shared, in accordance with applicable international access and benefit-sharing instruments.

Contribution of NBAP, or other relevant Government policy, to the Global Biodiversity Targets -Ireland has recently ratified the Nagoya Protocol and will put in place an operational framework to facilitate implementation in conjunction with other stakeholders/competent authorities across sectors and other Government agencies

In addition, whilst not mentioning genetics directly, the following relate to genetic diversity and would benefit from the proposed metrics under Outcome 2B: Biodiversity and ecosystem services in the wider countryside are conserved and restored – agriculture & forestry (my underlining)

- 2A7 Údarás na Gaeltachta will undertake a review of estates and lands within their operational zones, with a view to creating site specific management plans; identifying areas within or ecologically connected to Natura 2000 lands to support delivery on the conservation objectives of these sites; identifying lands suitable for inclusion in the All-Ireland Pollinator Plan and potentially become a partner in the plan; identifying

	lands suitable for Biodiversity Corridors, imitating the structure and diversity of native vegetation. ● 2B3 NPWS and DAFM will support Farming for Nature initiatives that specifically enhance ecological connectivity in the landscape, including initiatives in Northern Ireland through the Shared Island Fund. ● 2B12 By 2027, a diversified national and local native plant stock is available for tree and landscape planting schemes. Local Authorities, Transport Infrastructure Ireland (TII), NPWS and OPW will encourage a more reliable supply and use native species, varieties, and landraces from appropriate native sources in their landscaping works, where possible. Availability of national/local sources of native species, varieties, and landraces.
Japan	生物多様性国家戦略2023-2030 ～ネイチャーポジティブ実現に向けたロードマップ～ (National Biodiversity Strategy 2023-2030: Roadmap towards realizing nature positive) Related targets are: ● State target 1-3 The **genetic diversity** is maintained. ● Action target 1-6 Implement measures with consideration given to the **genetic diversity**, among others. ● Action target 3-3 Implement ABS on the utilization of **genetic resources**. Related to conservation of **genetic diversity** of wild species: To reduce anthropogenic impact on wildlife evolution as much as possible, strengthen comprehensive wildlife conservation of both rare and common wildlifes, and not only species diversity, but also regional populations **i**ncluding **genetic diversity**. In addition, reconstruct the appropriate relationship between humans and wildlife in light of changes in nature and society. In order to effectively promote these efforts, strengthen the cooperative framework of relevant government ministries and agencies. Through these efforts, ensure the health of ecosystems at various levels, from the ecosystem level to the **genetic level**, and restore the health of ecosystems that also contribute to resilience to climate change and other factors.

Since artificial release of living organisms (including hybrid individuals) into the wild may have an impact on the conservation of regional biodiversity, including the conservation of **genetic diversity** and the issue of domestically-originated alien species and foreign-originated native species, organize how to handle these issues and take necessary measures so it does not cause significant disturbance to biodiversity.

Since ensuring the integrity of all three levels of biodiversity (ecosystems, species, and genes) is essential for the overall health of Japan's ecosystems, set state targets for integrity at each level.

In addition, set action targets to address the direct causes of biodiversity loss toward the achievement of those states, as well as action targets for conservation measures that focus on the species and the **genetic diversity** within the species.

At the **genetic level, a**s pressure on species increases, habitat areas and networks are lost, and populations cannot maintain a certain level of cohesion within species, resulting in loss of **genetic diversity**. Considering these facts, it is necessary to prevent further loss and take measures to restore **genetic diversity** (Action Target 1-6) and maintain **genetic diversity** (State Target 1-3).

It is necessary to promote technologies and services that make a positive contribution to biodiversity in all business activities (Action Target 3-2). At the same time, it is required to promote the sustainable use of biological resources and their return benefit to biodiversity conservation through fair and equitable sharing of the benefits arising from access to and utilization of **genetic resources** (Action Target 3-3).

In accordance with the Guidelines for Slope Revegetation in Natural Parks, take necessary consideration to the use of local species and seedlings in order to prevent **genetic disturbance** and avoid the use of foreign cultivars of native species for revegetation in national parks.

Action Plans:
Genetic diversity is a component of biodiversity, along with ecosystem diversity and species diversity. A decline in **genetic diversity** will threaten the persistence of species and increase the likelihood of their extinction. **Genetic diversity** may be declining not only in rare species with small populations, but also in species with fragmented habitats and shrinking population sizes.

	In addition to promoting an understanding of the actual status of the species, **conserve genetic resources** through seed saving and other measures for species that are at high risk of extinction. Since there is a high possibility of **genetic differentiation** between native species naturally distributed in Japan and the same species distributed outside of Japan, there is concern that the introduction or artificial release of alien species into the wild may cause hybridization with native species and impact the conservation of local biodiversity. Regarding genetically modified organisms, take appropriate measures in accordance with the Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms. Promote conservation of individual populations (in situ conservation) based on **genetic diversity** assessments, mainly of species subject to conservation and reproduction programs of Act on Conservation of Endangered Species of Wild Fauna and Flora. Maintain and ensure the **genetic diversity** of rare species through a complementary combination of effective ex situ and in situ conservation in cooperation with zoos, aquariums, botanical gardens, insectariums, etc., in accordance with the status and characteristics of the species. Promote cultivated fisheries that take into account the sustainability of ecosystems and resources based on the "Technical Guidelines for Reducing the Risk of Impacts on **Genetic Diversity** Related to the Release of Artificial Juvenile Fish".
Republic of Korea (South Korea)	**The Republic of Korea's Fourth National Biodiversity Strategy 2019 – 2023** Conducting genetic research on important biological resources ● Carry out trial research to identify and monitor on a regular basis the genetic diversity of endangered species, endemic species and species with high economic value. ● Use the results for group conservation by species and as scientific evidence to support the identification of priority species for management, listing/delisting of endangered species and selection of species to be introduced for recovery.

- 202 cases analyzed as of 2018. 356 species will be analyzed from 2019 and 2026 (32 cases/year).

Sustainable use of fishery resources

- Cultivate sea forests (3,000 ha per year) to recover coastal ecosystems (forests of 15,252 ha in 129 locations had been created as of 2017). Release strategic species and monitor their genetic diversity.

Continuing efforts are required not only for the ex situ preservation of cultivated species for future use but also for the conservation of the **genetic diversity** of cultivated species grown in situ.

Facilitate in situ conservation based on **genetic diversity** assessments and enhance management techniques for forest **genetic resource** protection zones Assess the **genetic diversity** of forest **genetic resources** and enhance in situ conservation technologies

Restore **genetic diversity** through reintroduction

Identify the status of the **genetic diversity** of endangered species, endemic species and species with high economic value, and conduct a pilot study for regular monitoring.

- Develop molecular markers to identify the origin of major indigenous species and classify the group.
- Identify all **genetic** components, structures and properties of species and utilize the results to discover useful genes for conservation and sustainable use

Identifies numerous agencies responsible: MSIT, MOHW, ME, MOF, RDA, KFS.

- the Ministry of Science and ICT (MSIT), the Ministry of Health and Welfare (MOHW), the Ministry of Environment (ME), the Ministry of Oceans and Fisheries (MOF), the Rural Development Administration (RDA) and the Korea Forest Service (KFS)

Serbia	**Nature Protection Programme Of The Republic Of Serbia For The Period 2021-2023**

The decrease of biological diversity in the Republic of Serbia arose as the consequence of the disappearance,degradation and fragmentation of habitats, reduction in wildlife species' population numbers, vulnerability of the conservation of **genetic diversity** of various native populations of plant and animal species, the introduction of invasive and allochthon species and GMOs in nature, climate change, natural disasters, and human impact

Genetic resources in the Republic of Serbia are highly diverse and cover a large number of native varieties of domestic plant species and breeds of domestic animals. **Genetic resources** of importance for food production and agriculture and maintained in traditional agricultural systems or in ex-situ conditions. The Republic of Serbia is characterised by a large **genetic**, species, ecosystem and landscape diversity.

Research and analyses produced to date regarding the **genetic diversity** of plants in the Republic of Serbia were conducted on certain genii and/or species, mainly as part of larger regional projects, usually at the European or global level. In this regard, there are certain results in the field of **genetic differentiation** of types of genii: Asyneuma, Cerastum, Edraianthus, Hypericum and Ramonda, and for certain species of moss.

The **genetic diversity** of certain populations or groups of populations of animal species inhabiting the territory of the Republic of Serbia is known based on the results of an analysis of the **genetic variability** of populations within the entire range.

- Thus, the level of **genetic differentiation** of populations in the Republic of Serbia is known for some wild species under the exploitation regime, such as the horned viper (*Vipera ammodytes*) or green frogs (*Rana synklepton esculenta*), or these are species of game/mammals, such as the roe deer (*Capreolus capreolus*) and other species.

- Studies indicate that these populations require particular attention from the aspect of conservation, since they contribute significantly to the total **genetic diversity** of these species. Testing has also been performed of the **genetic diversity** of certain species of fish, such as the brown trout (*Salmo trutta*), grayling (*Thymallus thymallus*), sterlet (*Acipenser ruthenus*), and certain species of barbels from the genus *Barbus.*

Genetic resources (in the sense of total diversity of DNA structure among species that are directly or indirectly used by human beings) represent a key

component of agro-biodiversity. The agro-biodiversity of the Republic of Serbia covers species and habitats of cultivated plants and animals, and species and ecosystems important for the production of human food and animal fodder (species in agro-ecosystems, pastures and meadows, forest and aquatic ecosystems).

Plant and animal **genetic resources** are of key importance for the sustainable development of many rural areas of the Republic of Serbia, but simultaneously the conservation of these resources is conditional, inter alia, on the still insufficiently active role of the rural population in the nurture, sustainable use and economic valuation of agro-biodiversity.

Plant **genetic resources** are natural resources important for feeding people and animals, and providing raw materials for industry. The conservation, research, collection, characterisation, valuation and documentation of plant **genetic resources** for food and agriculture are of key importance for achieving international goals defined by the FAO Rome Declaration on World Food Security and World Food Summit Plan of Action (Rome, 1996 and 2009). The FAO International Treaty on Plant Genetic Resources for Food and Agriculture was signed in 2002, confirmed by the Republic of Serbia with a Law in 2013 (The Official Gazette of the Republic of Serbia – International Agreements, No. 1/13). The goals of this treaty are the conservation and sustainable use of plant **genetic resources** for food and agriculture, and equal participation in the distribution of benefits stemming from their use, in accordance with the Convention on Biological Diversity.

In the Republic of Serbia, the conservation of plant **genetic resources** is performed in two basic ways: in-situ and ex-situ. The **genetic resources** of fruits and grapevines in the Republic of Serbia are maintained in-situ in private farms and in cooperation with state institutions: experimental farms of agricultural faculties in Belgrade and Novi Sad, Institute for Fruit Cultivation in Čačak and Institute for Viticulture and Wine Production in Niš. The majority of **genetic resources** are currently protected ex-situ, i.e. outside their natural habitats, in a Bank of Plant Genes and in collections of breeding institutes in the Republic of Serbia. The number of samples and names of groups of crops currently in the National Collection of Plant Genetic Resources kept at the Bank of Plant Genes (a total of 4,238 samples from 249 plant species) is shown in the following table.

Animal **genetic resources** cover all species, breeds and strains that have a scientific, cultural or economic importance for a state. According to the Rulebook on the List of **genetic** reserves of domestic animals, method of conservation of **genetic** reserves of domestic animals and the List of native breeds of domestic animals and endangered native breeds (The Official Gazette of the Republic of Serbia, No. 33/17), 10 the following native breeds of domestic animals have been defined, as presented in the following Table.

Independently of cultivated plants, a considerable contribution to the total agrobiodiversity of the Republic of Serbia is provided by wild plant species of importance for food production and agriculture (fodder crops, medicinal and aromatic plants, decorative plants, honey plants, and wild fruit species, microorganisms and fungi), as well as meadows, pastures, border and ruderal habitats, including weed flora and vegetation.

The total number of medicinal and aromatic plant species in our flora is around 700, with 420 officially registered, and around 280 in circulation. Honey plant species are primarily components of meadow, forest and agro-ecosystems, with their number in the Republic of Serbia 11 estimated at around 1,800. Studies of the diversity of weed flora in the Republic of Serbia to date have shown that the number of weed species understood in the broadest sense comprises about 28% of the total flora.

From the standpoint of biodiversity and ecosystem services, of greatest importance are natural tall components of forests of natural origin. In forests of natural origin, 38 species of trees have been recorded, with two allochthones (black locust tree and Douglas fir, present in low numbers according to the National Inventory of Forests). The best-represented species is the beech with 40.5% of share in the total volume. Within native forest **genetic resource**s the highest value is held by endemic and endemic-relic taxa (*Pinus peuce, Pinus heldreichii, Pinus nigra subsp. gocensis, Picea omorika, Taxus baccata, Prunus laurocerasus, Acer heldreichii, Fraxinus pallisiae, Forsythia europaea, Corylus colurna, Daphne blagayana, Daphne mesereum*, etc.). Furthermore, within forest **genetic resources**, of high importance are also wild fruit species as **genetic resource**s for food and agriculture (there are 88 wild fruit species registered, 12 of them in considerable decline in numbers), particularly in the breeding of fruits, grafting, and as a resource being gathered. Another considerable **genetic** and economic resource are truffles, present as symbionts in many deciduous forests.

Among **genetic resources** of medicinal and aromatic plants, the highest importance is held by the **genetic diversity** of economically important species (chamomile, mint, sage, St. John's wort, yarrow, oregano, bearberry, valerian, plantago, primrose, etc.), and of species with limited ranges and those in decline for various reasons. More attention needs to be given to the assessment and monitoring of the status of populations of **genetic resources** of medicinal and aromatic plants and the need for their preservation. There are currently 63 plant species, ten species of lichen, 15 species of fungi, and 9 species of animals under control.

…integrate ecological corridors, as part of identified Trans-European Nature Network to prevent **genetic isolation**, allow for species migration, and maintain and enhance vitality of Ecosystems…
Hunting, fishing and gathering from nature, legal and illegal, can be the causes of endangerment or extinction of certain species and reduction of **genetic variability** of certain species.

Endangered **genetic diversity** of wild plant and animal species, as well as cultivated plants, bred and domesticated animals and their wild relatives represents another danger for the conservation of biodiversity in the Republic of Serbia

Extremely negative socio-economic changes in rural areas, production systems with large investments and one-way selection in domestic livestock lead to a reduction in **genetic variability.** For example, the introduction of new methods of selection, crossbreeding and giving preference to uniformity in poultry farming for the use of meat and egg production has led to reduction in **genetic diversity** in domestic poultry breeds inadequate conservation of **genetic diversity** of native flora and fauna species, introducing invasive and allochthones species and genetically modified Organisms.

Establish a national programme to identify and monitor priority species, habitats and **genetic** components of biodiversity, as well as the causes and consequences of activities and processes that threaten the components of Biodiversity- referred to The development of a system for monitoring the state of agricultural **genetic diversity** has begun, which will be regulated by the future Law on the Management of Plant Genetic Resources for Food and Agriculture

Spain	**BOLETÍN OFICIAL DEL ESTADO: Plan Estratégico Estatal del Patrimonio Natural y de la Biodiversidad a 2030** (OFFICIAL STATE BULLETIN: State Strategic Plan for Natural Heritage and Biodiversity to 2030) In 1992, Spain signed the Convention on Biological Diversity (CBD), whose main objectives are the conservation of biological diversity, sustainable use of its components and the fair and equitable distribution of the benefits derived from the access to **genetic resources.** Climate change is already having repercussions on biodiversity, from the **genetic level** to the ecosystem. Conservation of species and habitat types. General objectives: Maintain wild **genetic resources** that provide services in multiple areas and whose access and the distribution of benefits they generate continue to be agile and well regulated, thus contributing to the conservation of the species of origin and their habitats. The Royal Decree 159/2022, concerning the preservation of forest **genetic resources** and wild flora, establishes the National Bank of Forest Germplasm and Wild Flora. This bank is a member of the Network of National Centers for Forest Genetic Resources within the Ministry for Ecological Transition and the Demographic Challenge. From 2022 onwards, actions will be undertaken to effectively conserve the material of forest species of interest with respect to their **genetic resources,** as well as the taxa of flora listed under the List of Wild Species in Special Protection Regime. Special attention will be given to species listed in the Spanish Catalog of Endangered Species, ensuring their availability and addressing the conservation and reintroduction needs outlined in Conservation Strategies or Recovery or Conservation Plans. Furthermore, Royal Decree 159/2022 establishes the Networked Forest Germplasm and Wild Flora Bank as an additional tool for coordination and collaboration to support ex situ conservation. From 2022 onward, necessary actions will be taken to ensure its full operational functionality. These actions will be complemented by the adoption in 2023 by the Sectoral Conference on the Environment of guidelines for the ex situ conservation of wild flora. These guidelines will lay the foundation for promoting coordinated and networked work among **genetic** and biological material banks and public administrations.

In order to reduce the risk of use throughout the national territory of resources **genetic resources** and traditional knowledge associated with **genetic resources** obtained from illegally, both in Spain and in third countries Party to the Nagoya Protocol, will be adopted before 2023, the State Plan for the control of the legality of the use of **genetic resources** and associated traditional knowledge in Spain, in accordance with the provisions of Royal Decree 124/2017, of February 24, regarding the access to **genetic resources** from wild taxa and the control of utilization.

Restoring ecosystems to recover and conserve natural heritage and biodiversity, ensuring ecological connectivity and the conservation of landscape values, and guaranteeing the provision of ecosystem services, with a priority on the utilization of nature-based solutions. Collectively, by 2030, 15% of degraded ecosystems will be restored.

Within the framework of the National Strategy for Green Infrastructure and Ecological Connectivity and Restoration, the identification of the elements that may be part of the Green Infrastructure will be carried out until 2024.

To ensure the functionality of the biodiversity of the terrestrial and marine territory in the long term, and as part of the lines of action of the National Strategy for Green Infrastructure and Ecological Restoration and Connectivity, the Public Administrations will assess and identify the elements of the territory that They provide current or potential value from the point of view of green infrastructure, that is, areas of special importance for the provision of ecosystem services, maintenance of biodiversity and ecological connectivity.

In relation to noise pollution, there is increasing evidence of the significant effects that aerial and underwater noise can generate on biodiversity(56), which may be a cause of reduction in the quality of the available habitat and affect the distribution and population size of sensitive species, and permanent damage may even occur to the body (particularly to the hearing organs) when noise levels are very high.

Regarding the impact of climate change on biodiversity, a specific strategy for the conservation and restoration of species and ecosystems that are especially sensitive to the effects of climate change will be approved and applied, which will include wetland, aquatic or water-dependent ecosystems, including riverbank areas, high mountain areas, and Posidonia meadows and other

	seagrasses, as well as those that stand out for their role in adaptation to climate change.
Tunisia	**Stratégie et Plan d'Action Nationaux pour la Biodiversité 2018-2030** (National Strategy and Action Plan for Biodiversity 2018-2030) Terrestrial wild animal **genetic resources** are represented by amphibians (7 species), reptiles (63 species), birds (407 species) and mammals (78 species). Marine **genetic resources** are made up of 600 plant species and 2,622 animal species, 36 of which are classified as endangered or threatened in the annexes of the Barcelona and/or Berne Conventions. The International Treaty on Plant **Genetic Resources** for Food and Agriculture Reducing the rate of impoverishment of the constituent elements of biodiversity, with its three hierarchical levels (ecosystems, species and **genetic diversity**). The protection of traditional knowledge, innovations and practices and the fair and equitable sharing of the benefits arising from the use of **genetic resources** Insufficient knowledge on the components of biodiversity, **genetic erosion** and ecosystem functions Accessing **Genetic Resources** and Sharing the Benefits of their use (APA) Action 2: Develop and implement a sui generis system for the protection of traditional knowledge related to **genetic resources** Action 21: Develop and implement a sui generis system for the protection of traditional knowledge related to **genetic resources** Action 36(b): Conserve and protect **genetic resources** and optimize their contribution to socio-economic development Action 39(a): Update and implement the conservation and valorization strategy of local agricultural **genetic resources** and their action plan

	Action 39(b): Strengthen the **genetic** improvement and conservation programs of traditional and local cultivated varieties and domestic animal species Action 40: Strengthen the capacities of the BNG and other institutions for the characterization and conservation of existing plant and zoo-**genetic resources**
Published on CBD CLearing House Mechanism prior to 2020	
Argentina	**Estrategia Nacional Sobre la Biodiversidad Plan de Acción 2016-2020 Republica Argentina** (National Strategy on Biodiversity Action Plan 2016-2020 Republic of Argentina) Biodiversity […] encompasses the **genetic diversity** of populations, species, and ecosystems. In addition, [biodiversity] provides a key contribution to maintaining the variety of crop **genetic resources**. An ecosystem-based approach to biodiversity conservation from a landscape scale perspective can improve the conservation status of wild species, as well as the well-being and quality of life of the people who depend on them. One sub-axis focused on the Conservation of wild species and their **genetic diversity** at the population level. This is achieved by guaranteeing the conservation of species, populations, and genes, ensuring the conservation and recovery of wild populations and their habitat. This includes the conservation of **genetic variability**, which is crucial for the demographic viability of sub-populations, and their connectivity and distribution throughout Argentina's ecoregions and subregions. One of the priority research topics is **Genetic Resources** with the following aims: To promote the generation of knowledge about the country's **genetic resources**. To carry out a survey, diagnosis and registration of the existing Banks of National Genetic Resources.

Training and dissemination workshops for companies and other private actors related to **genetic resources**. To increase awareness of **genetic resources** and to promote national and international regulations.

Training in sustainable agricultural practices. To provide training on the management of exotic species and genetically modified organisms, in order to avoid the inadvertent introduction of invasive organisms, and to mitigate associated risks, both environmental and **genetic** as well as to minimize the ecological displacement of local species and ecotypes.

Axis 5 focuses on Genetic Resources. The Argentinean NBSAPs adopt the definitions of genetic material and genetic resources established in Article 2 of the CBD through Law No. 24,375. **Genetic resources** are critical for Argentina's development, **genetic diversity** is essential for species survival and overall biodiversity conservation. Populations with lower **genetic diversity** have a reduced capacity to adapt to future environmental changes, increasing their extinction risk.

Genetic Resources Networks Ex situ conservation is recommended as a support to in situ conservation to maintain individuals and genes of species that are in critical danger in nature; generally, through the maintenance of populations in botanical gardens and other spaces that can house and propagate organisms. At the **genetic** level, there are seed banks, tissue culture and germplasm banks (animal and plant), and microorganism banks, among others. That is why it is also essential to strengthen the networks of national and provincial **genetic resources**, promoting cooperation, the exchange of knowledge and research actions, with greater emphasis on native and endemic species.

To promote the creation of incentives for the conservation of **genetic resources** and their sustainable use, which improve and boost the contribution of biodiversity to sustainable development and human well-being.

To establish a System of Articulation for the Management and Administration of Genetic Resources, as a space for interjurisdictional articulation to generate agreements and seek consensus on issues related to **genetic heritage**, which allow the implementation of policies, programs and projects in an articulated manner.

	Protect **genetic heritage** in the public interest by storing **genetic resources** in germplasm banks, gene banks, microorganism banks, rescue and/or rehabilitation centers, cryoconservation, botanical gardens, nurseries, herbaria, museums, and others. Strengthen and promote nurseries of native species and for the regeneration and restoration of strategic environments. Carry out a survey, diagnosis and registration of the existing **National Genetic Resources Banks**. Ensure that access to **genetic resources** stored in the networks contemplates fair and equitable participation in the benefits derived from their use.
Brazil	**National Biodiversity Strategy And Action Plan 2017** Biodiversity Strategic Objective C: Improve the status of biodiversity by safeguarding ecosystems, species and **genetic diversit**y. National Target13: By 2020, the **genetic diversity** of microorganisms, cultivated plants, farmed and domesticated animals and of wild relatives, including socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing the loss of **genetic diversity.** Conservation of agrobiodiversity (genetics) • Support to research on **genetic diversity** Support to the ex-situ conservation of the Brazilian **genetic heritag**e (Projects under the National Fund for Benefit Sharing) ● Conserve the **genetic diversity** of local traditional or crioula varieties locally adapted by indigenous peoples, traditional communities and family rural producers.
Colombia	**BAP Biodiversity Strategy and Action Plan for the Implementation of the National Policy for the Integral Management of Biodiversity and its Ecosystem Services 2016-2030** At sea level, 57 species (27 marine and coastal species and 30 species from ballast water) are identified: including lionfish (*Pterois volitans*), with the ability to threaten the viability of wild species, reducing **genetic diversity** and transmitting diseases to wild flora and fauna and even to humans.

Indonesia	**Indonesia Biodiversity Strategy and Action Plan 2015-2020**

Strategic Plans of Ministry of Forestry 2010-2014-results. Fifteen programs (31 percent) of the total 48 activity programs determined in the ministry's strategic plan conformed to the activity programs of the IBSAP, including: development of species and **genetic** conservation; implementation of forest and land rehabilitation, as well as forest reclamation in priority riparian areas; forest area use control; and forest investigation and protection.

Genetic diversity is recognized as one of the three layers that make up Biodiversity: 3. Genetics Diversity: **Genetic diversity** is the diversity of individuals in a species. This diversity is caused by interindividual **genetic** differences. Genes are the characteristic carrier factors of each organism and may be inherited from one generation to another. As such, the individual in a species carries the gene structure that is different from the gen structure of other individuals. For example, this is shown in the diverse paddy varieties (such as Rojolele, Menthik and Cianjur) or mango varieties (golek, harum manis and manalagi).

Genetic diversity currently supports the agricultural and medicine

Figure of **Genetic Diversity** in relation to resources/ domesticated/ farmed species.

As such, **genetic diversity** can become part of the health resources and food security of countries, including Indonesia.

This concern was highlighted by the Food and Agriculture Organization (FAO) in 1999, namely that 75 percent of the **genetic diversity** of agricultural plants had disappeared. We refer to this phenomenon as **genetic erosion**. LIPI in 2014 identified **genetic diversity** in the form of **genetics resources** of animals, plants and microbes (see Figure 3.22). **Genetic resources** are grouped in **genetic resources** of animals, plants and microbes.

Genetic diversity in living things (plants, animals, and microbes) is the basic material used in developing cultivars, varieties and species that can be utilized by humans. Erosion of sources of **genetic diversity** results in a serious threat to food security, shelter, and energy for the long term.

	Erosion of sources of **genetic diversity** results in a serious threat to food security, shelter, and energy for the long term. Indonesia is among countries that possess a protected area management system that functions as an in-situ conservation effort, i.e. efforts to protect the ecosystems and natural habitats for the conservation of species and **genetics diversity**. ● In addition, Indonesia also has an ex-situ preservation site. At present, there are biodiversity institutions as stated in the technical implementing unit (UPT), among others the management of in-situ and ex-situ conservation areas. The Biological Research Center implements its research activities at the ecosystem, species and **genetic** levels. Collected data are the terrestrial ecosystem types, plant reference collections (herbarium and living collections), zoological museum reference specimens, a collection of microorganisms, and the collection of **genetic diversity** in the form of DNA. Ministry of Agriculture Preservation of **genetic diversity**, in particular for agricultural crops and livestock, are implemented to manage the collection that is used to renew seeds and seedlings, as well as efforts to develop seeds and seedlings with a better productivity and quality/ endurance(living collection). Many regulations on biodiversity have been issued but remain sector-based and only focus on commodities. Therefore, conservation functions, utilization and benefits sharing as the objectives of CBD cannot be optimally reached, and have yet to be accommodated at the **genetics**, types and ecosystem level.
Papua New Guinea	**Papua New Guinea National Biodiversity Strategy and Action Plan 2014-2024** **Genetic diversity** is the variety of **genetic** information stored in individual plants, animals and micro-organisms. Biodiversity is constantly evolving. It can be increased by **genetic** changes and evolutionary processes, or it can be reduced by threats that lead to biodiversity population decline and extinction. The NBSAP also outlines Papua New Guinea's strategy to ratify and implement

	the Nagoya Protocol on Access to **Genetic resources** and Benefit-Sharing to achieve the third objective of the CBD. Like the Fisheries Policy, the Forestry Policy also had a narrow focus on commercial production with little or no emphasis on **genetic** and biodiversity conservation. Like the Fisheries Policy, the Forestry Policy also had a narrow focus on commercial production with little or no emphasis on **genetic** and biodiversity conservation. PNG's environmental sustainability strategy covers three SDGs (2, 14 and 15), with dimensions of biodiversity addressed (**genetic diversity**, SDG 2), ecosystem and species diversity (SDG 14 and SDG 15). National Target 9: ● Strengthen and develop effective national strategies for conservation PNG's rich Plant Genetic Resources (PGR) ● Effective conservation and maintenance of ex-situ collection of crop **genetic resources** National Target 13: **Genetic diversity** of PNG's seeds and cultivated plants and wild relatives protected and maintained in secured facilities ● 13.1 By 2030, maintain the **genetic diversity** of seeds, cultivated plants and farmed domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national level, and promote access to and fair and equitable sharing of benefits arising from the utilization of **genetic resources** and associates Number of plant and animal **genetic** resources for food and agriculture secured in either medium or long- term conservation facilities
Uruguay	**Estrategia Nacional para la Conservación y Uso Sostenible de la Diversidad Biológica del Uruguay 2016 - 2020** (National Strategy for the Conservation and Sustainable Use of the Biological Diversity of Uruguay 2016 - 2020) Submitted to CBD 11 August, 2016

The National Biodiversity Strategy establishes the national policy for the conservation and sustainable use of biological diversity, being the base instrument for the management of ecosystems, species and **genetic resources**

Conservation of biological diversity, sustainable use of its components, and the fair and equitable sharing of benefits derived from **genetic resources**.

Mention to the International Treaty on Plant **Genetic Resources** for Food and Agriculture: Conserve and sustainably use plant **genetic resources** for food and agriculture [...]

Fair and equitable sharing of benefits derived from the use of **genetic resources**.

Multiple mentions to GMOs here, in relation to a biosecurity law

[...] hosts an important biological diversity at the eco-regional; ecosystemic, specific and **genetic** levels

The Uruguayan territory constitutes the Southern and Eastern limits of the distribution of multiple native tree species. This is an important element to be considered in relation to the importance of national **genetic resources** conservation programs

The varieties of creole seeds resulting from the selection that the producers have done over the years to adapt crops to our environmental conditions, are a reservoir of **genetic diversity** of great importance, presenting ecophysiological adaptations for the development of agriculture and the **genetic improvement** of cultivars. The available information indicates the existence in our country of native varieties of corn, onion, carrot, beans, peas, garlic, and bell pepper, among other crops, which harbor a **wide genetic diversity**

Concerning plant genetic resources, the populations of several tree species are located within the southern and eastern limit of their natural distribution in the Uruguayan territory. This determines the existence of an **important genetic variability**, highlighting their great importance for **genetic** improvement programs.

Invasive exotic species (IAS), whether flora or fauna, cause serious damage to biological diversity at the level of ecosystems, species or **genetic resources**.

Ex situ conservation and access to **genetic resources** are among the topics that made the least progress in the period 1999 – 2013. [...] Greater efforts should focus on the topics of **genetic resources**, ex situ conservation and environmental impact

Ex situ conservation will be strengthened in the country as a complement to in situ conservation and as a direct action to support **genetic resources** valorization, research in biological diversity in general, and environmental education

Mention of an ongoing action: Legal framework for the creation and operationalization of a **N**ational System of **Genetic Resources** and for regulating access to **genetic resources**. Promote scientific production and valuation of **genetic resources**. Rescue populations with risks of **genetic loss** or erosion

Cooperation policy established between countries related to biological diversity research should be in accordance with the proposed strategy on Access to **Genetic Resources** and technologies

The full exercise of the sovereignty of the country over **Genetic Resources** and the capacity of the national government to regulate their access are essential tools to achieve the conservation and sustainable use of biological diversity and its fair and equitable distribution

Strengthen the scope of FAO as an international organization competent to regulate through a binding agreement on the use of **genetic resource**s currently used for agriculture and feeding - Support the making of multilateral agreements for access to **genetic resources** - Propose the coordination of policies on access to **genetic resources** at the MERCOSUR level, especially for shared species.

Mentions to genetic diversity and erosion related to the description of the Aichi target 13: By 2020, the **genetic diversity** of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing **genetic erosion** and safeguarding their **genetic diversity**

	Mentions to **genetic resources** related to the description of the Aichi target 16: By 2015, the Nagoya Protocol on Access to **Genetic Resources** and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation. Another mention to **genetic resources** here to state that national policies related to Nagoya protocol were planned to be effective by 2018. On the other hand [...] we aim to revalue the contribution to biodiversity of Creole **genetic resources**, a product of the work that producers have done for years to select the seed varieties that are most adapted to our environmental conditions. Risk assessment and control of genetically modified organisms and their associated technological package Set the foundations for the development of a National Inventory of **Genetic Resources**. The Parliament approved the creation of a National Environmental Observatory that includes among its powers the adoption and update of indicators, among which those related to the quality of biodiversity, to the levels and protection measures of ecosystems and of **genetic resources,** and the identification of mechanisms and measures of public participation in environmental management. Develop the regulatory framework for **Genetic Resources** [...] the State must assume a strong commitment through this strategy that seeks to clearly reflect the diverse interests of society (and especially, of those from the most disadvantaged sectors) in decisions linked to the benefits obtained from the use of **genetic resources** associated with our biological diversity.
Unofficial drafts (not yet submitted to CBD Clearing House Mechanism)	
Sweden	**Förslag till nationell strategi och handlingsplan avseende konventionen om biologisk mångfald (CBD) 2023** (Proposal for a national strategy and action plan regarding the Convention on Biological Diversity (CBD) 2023)

	Biodiversity means… different ecosystems that provide a rich variety of habitats, many different species that live in viable populations in the ecosystems, and genetic variation between and within the populations of each species. All these levels are necessary to preserve as they are mutually dependent and create conditions for species to adapt Special efforts to increase the effective population size of populations of native wildlife species with an effective population size below 500 have commenced by 2025. The number of populations of native wild species has been maintained or increased, and the proportion of those populations with effective population sizes greater than 500 has increased. The genetic diversity of domesticated species and breeds is secured in agriculture and forestry. Sustainable fishing practices will include maintenance of genetic diversity and avoidance of strong selective harvest that alters species' genetic diversity. The number of native wildlife species and populations that have been analyzed with regarding **genetic diversity** has increased significantly and the monitoring of **genetic diversity** is carried out on an ongoing basis. All native wild species subpopulations or geographic distribution maintained or re-established to strengthen **genetic diversity**, if ecological and technical conditions exist. Introduction of alien genotypes that are potentially harmful to biodiversity has been strongly limited until 2030 In the national implementation of the framework, it is important to take into account ecological representativeness and connectivity that contribute to genetic exchange between populations. TARGET: The adaptability of species is strengthened by preserving and enhancing genetic diversity
SADC	The Region's biodiversity thirteen priority areas include Unsustainable land management, Degradation of land, wetlands, and coastal areas, Pollution of

ecosystems, Over-exploitation of biodiversity, Climate change, Alien invasive species, Unsustainable agricultural practices, **Erosion of genetic resources**, Encroachment into conservation areas, Biodiversity economy, Access and benefit sharing and digital sequencing information on **genetic resources**, Effective governance, and Resource mobilization.

Priority A4: Over-exploitation of biodiversity and **genetic resource**s through legal poorly or unregulated and illegal activities. (Strengthening policies, law and regulations).

Priority 5: **Genetic Erosion** of biological resources

Objective A5: To safeguard **genetic resources** for current and future generations.

Target A5: Develop and execute comprehensive conservation strategies by 2035 to effectively mitigate the **genetic erosion** of biological resources, emphasizing the sustainable management of plant and animal **genetic diversity**, promotion of resilient agricultural practices, and establishment of seed banks or **genetic** repositories to safeguard **genetic resources** for current and future generations.

Output A5: A comprehensive conservation strategy for safeguarding g**enetic resources** developed and implemented by 2035

The SADC region is one of the highly biodiverse regions of the world (WCMC, 2000), characterized by noteworthy biodiversity, encompassing a variety of ecosystems, species, and **genetic resources**.

Biodiversity is essential for maintaining **genetic diversity** within plant and animal populations. This **genetic diversity** is crucial for the resilience of agriculture in the face of changing environmental conditions and the emergence of new diseases. (in the context of The SADC region's rich biodiversity plays a crucial role in maintaining ecological balance and supporting the well-being of the human population of Southern Africa)

Effective coordination and communication on a global scale are essential for addressing transboundary issues related to plant **genetic resources**. Challenges in coordinating efforts among countries and international organizations may hinder effective implementation.

Under SADC Priority for **Genetic Erosion** of biological resources: The reason why it is a priority states:

- Populations may experience diminished adaptability to environmental changes, reduced resilience to pests and diseases, and the loss of unique and potentially valuable traits and characteristics with negative implications for future breeding programs, medical research, and other applications reliant on **genetic diversity**. This can jeopardize food security by diminishing crop diversity, disrupt ecological interactions, leading to imbalances and potential cascading effects throughout the ecosystem. Moreover, these impacts may have adverse effects on rural livelihoods and sustainability, affecting communities dependent on agriculture and ecosystems. Additionally, the negative consequences may extend to ecotourism opportunities and the associated economic benefits. Recognizing the multifaceted significance of these issues, they are also a priority within Africa's Agenda 2063.
- Also goes on to note biotechnology and GMOs on this area.

Related to Strategy 1: Adopt integrated land use planning and management, Activity 2 states: Conduct regular comprehensive natural resources assessments and reporting for the key ecosystems, species and **genetic resources** using common internationally recognized scientific methods and formats, respectively, at regional and national levels

Under Strategy 6: In situ and ex-situ conservation of **genetic resources** for food and agriculture

- Activity 1: Develop and implement SADC **Genetic Resources Strategy** and Action Plans.
- Activity 2: Develop or update and implement national **genetic resources** strategies [that include identifying and prioritising species for in situ and ex-situ conservation (consider plant, animal, aquatics, forest **genetic resources**), create a database for the identified and prioritized species, implement the in situ and ex-situ conservation of the identified and prioritized species, and conduct awareness on in situ and ex-situ conservation].

Under Priority A5 (**Genetic erosion**),

- Strategy 2: Establish conservation facilities such as Gene Banks and preservation of **genetic** material of key specie

- Strategy 3: Effective PA management: Support Member States to identify and collect **genetic resources** on the verge of extinction, including crop wild relatives and related scientific information and traditional knowledge as well as support for the establishment of **genetic** reserves for in-situ conservation of SADC crop wild relative species.
- Strategy 4: Enhance in situ conservation. Support Member States in facilitating and enhancing on-farm conservation of **genetic resources** to ensure continued availability of traditional farm varieties/ livestock breeds for broadening the **genetic** base and increasing the resilience of agricultural production systems
- Strategy 5: Uphold and maintain traditional farming practices. Urge Member States to implement diversified crop rotations, agroforestry, and the conservation of traditional crop varieties, ensuring a resilient and diverse **genetic** pool for future generation
- Strategy 6: Research and Awareness.
    - Activity 1: Foster and support collaboration and knowledge exchange among researchers working on **genetic erosion** and related fields in the region and national levels.
    - Activity 2: Assist Member Countries to increase public awareness and understanding of **genetic erosion** and its consequences on biological resources.
    - Activity 3: Develop and implement programmes for Member States to empower local communities to actively participate in monitoring and addressing **genetic erosion** in their region
- Strategy 7: Capacity Building.
    - Activity 1: Secure expertise and appropriate technologies to inventory and document the **genetic diversity** of cultivated plants and their wild relatives, farmed and domesticated animals and their wild relatives, and other socio-economically and culturally valuable species in the region and Member countries.
    - Activity 2: Establish and strengthen regional and national institutions for planning and implementing measures (all above), and tracking the effectiveness of interventions in terms of conservation of **genetic diversity**.

Under priority area A7 Climate change adaptation.

- Strategy 2: Increase the use of sustainable adaptation measures
    - Facilitate joint research on the adaptability of **genetic resources** to promote food production systems

Under SADC's major Capacity Drivers for Biodiversity Priority Areas

- ….unsustainable agricultural practices **genetic erosion** of biological resources…

Noted capacity needs for all priority areas, including **genetic resource** conservation and Conservation biology, plant and animal breeding, seed banking and germ-plasm conservation, traditional crop varieties, in situ conservation, forest **genetic resources**, livestock **genetic** management, participatory plant breeding, aquatic **genetic resources** management**, genetic** monitoring and surveillance, legal and policy frameworks, climate-resilient crop development, molecular **genetics** and genomics, and indigenous and local community traditional knowledge

Budget allocations for the next 10 years to address/implement areas related to **genetic resources** over the whole SADC region:

- Over-exploitation: USD 10 425 000
- **Genetic resources erosion**: USD 11 325 000

Supplementary Document 2 for

How can biodiversity strategy and action plans incorporate genetic diversity concerns, plans, policies, capacity, and commitments?

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List of online resources for learning more about genetic diversity or finding experts in your country who can help with a BSAPs:

- Coalition for Conservation Genetics (CCG): a group providing coordination across initiatives in the conservation genetics space.
- IUCN SSC Global Biodiversity Framework Task Force: aim is to increase the input of scientific information on species from the Species Survival Commission into global discussions on the post-2020 biodiversity agenda
- IUCN SSC Conservation Genetics Specialist Group: mission is to promote the use of genetics in conservation management and decision making, to assist the Commission in applying genetics to threatened species and to lead the development and analysis of genetic data in conservation.
- IUCN SSC Conservation Planning Specialist Group: mission is to save threatened species by increasing the effectiveness of conservation efforts worldwide… by using scientifically sound, collaborative processes that bring together people with diverse perspectives and knowledge to catalyze positive conservation change. We provide species conservation planning expertise to governments, IUCN SSC Specialist Groups, zoos, aquariums and botanical gardens, and other wildlife organizations.
- Society for Conservation Biology (SCB) Conservation Genetics Working Group: aim of the CGWG is to promote the incorporation of genetic studies into the wider field of conservation and to improve the way results of genetic studies are communicated to the broader conservation audience
- GEOBON Genetic Composition Working Group: aims to develop, test and improve approaches for assessing and interpreting genetic diversity

- Genomic Biodiversity Knowledge for Resilient Ecosystems (GBiKE): An EU COST Action whose aims include clearly articulating for managers how genetic diversity can support ecosystems; developing and testing best practice protocols for monitoring genetic diversity in time and space; providing an online forum on emerging tools; connecting all stakeholders through networking and training opportunities; building a network of conservation genetics labs
- FAO Knowledge Hub: gathers existing knowledge and resources on biodiversity in the agriculture sectors to enhance countries' knowledge and capacity to implement the Kunming-Montreal Global Biodiversity Framework, deliver on the sustainable development goals and achieve food security
- the Domestic Animal Diversity Information System monitors population sizes of domesticated animal breeds around the world
- Convention on Biological Diversity (CBD) Ad Hoc Technical Expert Group on Indicators (AHTEG) and the current (April 2024) metadata sheets for indicators
- United Nations Environment Programme (UNEP)
- Crop Trust Genebank Resources on the Web: The webinar series explores topics ranging from emerging technologies, operational efficiency, collecting to seed longevity, policy and use. GROW aims to tackle difficult questions and provoke discussion on important genebank-related details and themes.
- International Barcode Of Life (IBOL) is a research alliance building DNA barcode reference libraries, sequencing facilities, informatics platforms, analytical protocols and international collaboration required to inventory and assess biodiversity.

European agencies/ groups:

- KCBD (Knowledge Centre for Biodiversity) and its Science Service
- COOP4CBD (Cooperation for the CBD): will enhance coordination within the European Union (EU) in advancing the implementation of the Convention of Biological Diversity by harnessing effectively the knowledge of EU experts
- EUFORGEN: an international cooperation programme that promotes the conservation and sustainable use of forest genetic resources in Europe as an integral part of sustainable forest management.
- LifeGenMon: A European project which developed guidelines for forest genetic monitoring for selected tree species, implementation manual and a decision support system for decision makers on establishing the forest genetic monitoring system in different countries and regions