The importance of genetic diversity for forests, nature and biodiversity conservation

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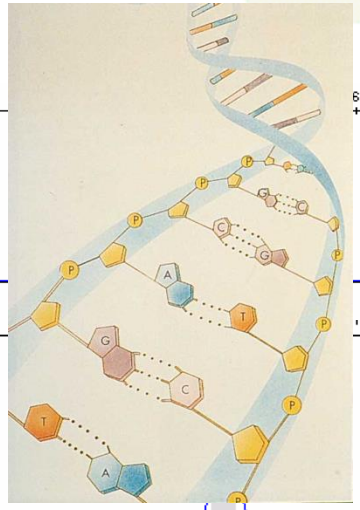


- LSFRI Silava conducts research on all topics related to forest ecosystems and primary production (ecology, breeding, climate change, forest regeneration and planting, phytopathology, entomology, wildlife management

- The Genetic Resource Centre is responsible for coordinating GR activities in Latvia (plant, forest, animal)
- Maintains the gene (seed) bank of cultivated plant species
- The molecular genetics lab conducts research on a wide range of plant, tree, microbial and animal species

Biodiversity

- Three levels of biodiversity recognized by the Convention on Biological Diversity (CBD), and other national and international conservation policies
  - Ecosystem diversity
  - Species diversity
  - Genetic diversity

Biodiversity

- Species diversity increases resilience
  - Under predicted climate scenarios, maintaining healthy, intact ecosystems will become increasingly important to avoid the worst impacts of climate change
- Biodiversity has positive impacts on ecosystems and ecosystem services.

Ecosystem services

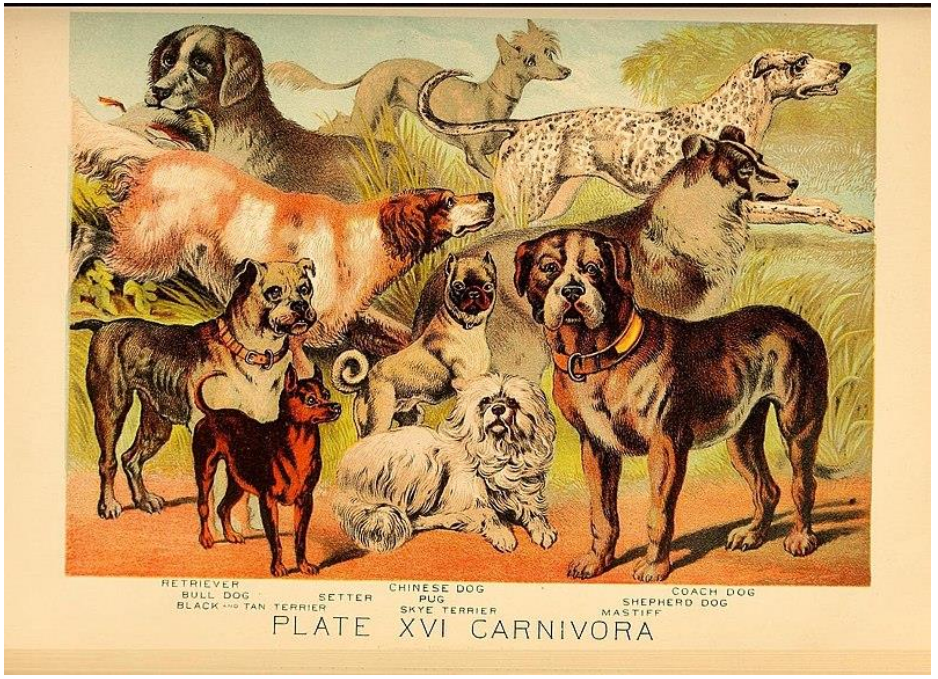
- Provisioning services
- Regulating services
- Cultural services
- Supporting services

Biodiversity

Genetic diversity

- Genetic diversity is the diversity between individuals within a species, encoded in DNA and expressed in diverse phenotypes and adaptations to environments.
  - Determines species' adaptive potential to environmental change,
  - Increases ecosystem resilience in the face of climate change and anthropogenic risks,
  - Supports all the other levels of biodiversity that deliver ecosystem services, benefiting people

Genetic diversity



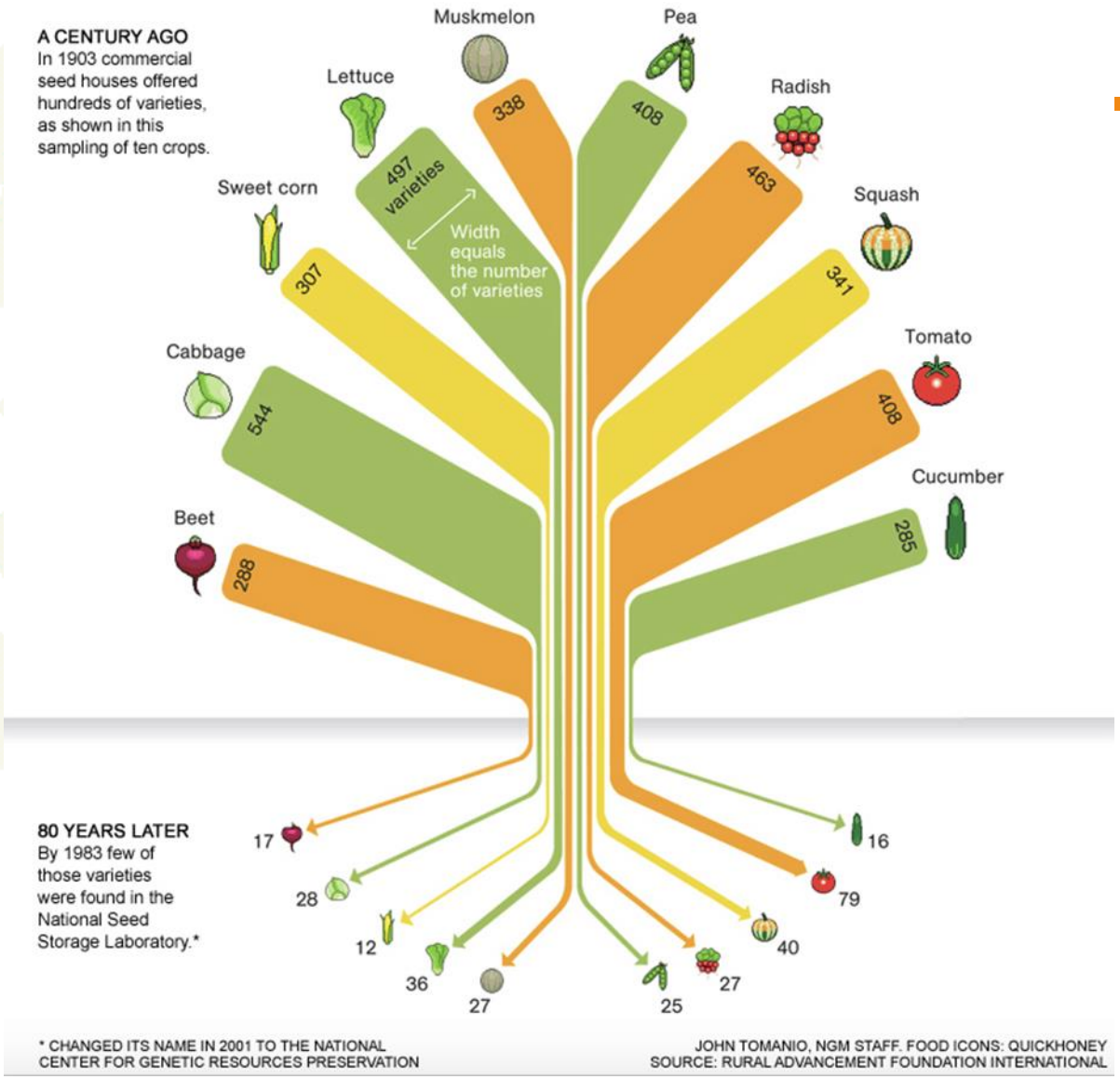
Genetic diversity

- Genetic diversity is variation at the DNA level. Genetic diversity is the basis of biological differences, both between species and among individuals of the same species.
- Because of genetic diversity, some individuals are better suited to survive and reproduce in certain conditions, and will be favoured by natural selection.
- Genetic diversity increases the probability of species survival, especially during environmental change. Genetic diversity is therefore crucial to the resilience of ecosystems and the production of ecosystem services.
- Populations that are small and isolated rapidly lose genetic diversity. Therefore, management should focus on enlarging and connecting populations above critical thresholds, to retain the capacity to adapt genetically to change.
- Measuring and monitoring genetic diversity enables us to better evaluate species health, genetic variation and the exchange of genetic variation across different populations (gene flow) to improve the management of biodiversity and natural resources.

Humans depend on ecosystems. We need to act and stand guard against the loss of biodiversity caused by human activities and climate change

Breeding

- Genetic diversity is the foundation of breeding programs
- Useful traits can be obtained from diverse sources (old varieties, crop wild relatives, natural populations)
- Moderns varieties often lack genetic diversity and in many cases are not adapted to local growing conditions, and therefore require inputs of fertilizers, pesticides and herbicides


A CENTURY AGO
In 1903 commercial seed houses offered hundreds of varieties, as shown in this sampling of ten crops.
Muskmelon
Pea
Lettuce
Radish
Sweet corn
Squash
Cabbage
Tomato
Beet
Cucumber
497 varieties
Width equals the number of varieties
338
408
463
307
341
544
408
288
285
80 YEARS LATER
By 1983 few of those varieties were found in the National Seed Storage Laboratory.*
17
28
12
36
27
25
27
40
79
16
* CHANGED ITS NAME IN 2001 TO THE NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION
JOHN TOMANIO, NGM STAFF. FOOD ICONS: QUICKHONEY
SOURCE: RURAL ADVANCEMENT FOUNDATION INTERNATIONAL

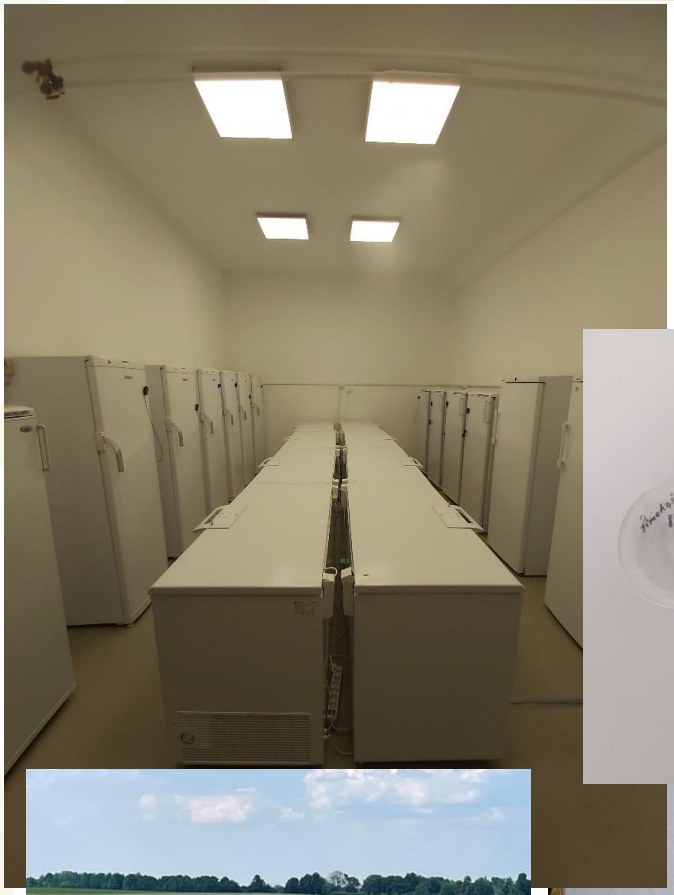
Genetic resources

- Genetic material of actual or potential value
- Historically, usually refers to cultivated (agricultural) species and germplasm used for breeding
- Increasingly, it is becoming more apparent that the value, use, and scope of genetic resources in much broader

Genetic resources

- Divided into (mostly) non-overlapping sectors
  - Plants, Forest trees, Farm animals, (Wildlife)
- *Ex situ* conservation
  - Gene (seed) banks, field collections, genetic resource stands
- *In situ* conservation
  - ‘in nature’: wild populations, can also mean ‘on-farm’
  - Populations growing in conditions where they can adapt

Ex situ conservation



In situ conservation

- Identification of valuable populations (and ensuring their protection)
- Periodic monitoring to ensure that they are still existing and viable (including genetic monitoring)
- Populations can consist of one target species or multiple species

Local adaptation

- Utilisation of local germplasm (varieties)
- Is of particular importance for long-lived organism such as trees
- (but also assisted migration can be used to facilitate adaptation to climate change)
- Increasing awareness about the importance of using local material for meadow and grassland restoration (including city meadows etc).

- Management to preserve biodiversity (genetic, species, ecosystem)
- Preservation of ecosystem services (including provisioning services)

- Biodiversity
- Ecosystem services
- Genetic diversity
- In situ conservation
- Local adaptation

Management

- Management strategies should optimally take all these issues into consideration

Management goals		Genomics-informed management actions
Population or species conservation	▷	reduce inbreeding to prevent inbreeding depression, preserve gene pools, assist colonisation, design conservation areas that maximise adaptive potential
Sustainable productivity	▷	identify populations (stocks) for management, breed for/promote productivity while conserving genetic diversity
Climate adaptation	▷	favour adaptive alleles while conserving genetic diversity, assisted gene flow, assisted colonization
Restoration	▷	perform climate-adjusted provenancing while conserving genetic diversity
Pest control	▷	monitor disease dynamics, identify and promote co-evolved resistance, prevent pest spillover
Microbial community management	▷	characterise community function and manage it, e.g., through associated vegetation or inoculation to promote desired properties
Control of invasives	▷	identify alien species to prevent invasion, identify invasive genotypes

Conclusions

- Genetic diversity is the foundation of resilient and adaptive populations
- It is the basis of species and ecosytem biodiversity
- Is absolutely required to provide ecosystem services

Conclusions

- Need to develop and use meaningful indicators of genetic diversity
  - Current CBD genetic diversity indicators neglect most wild species as they are restricted to domesticated species and their wild relatives.
  - Wild species are essential to ecosystem integrity and services, especially under climate change
- Integration of efforts among different sectors (agriculture, forests, nature management)

Thank you for your attention!

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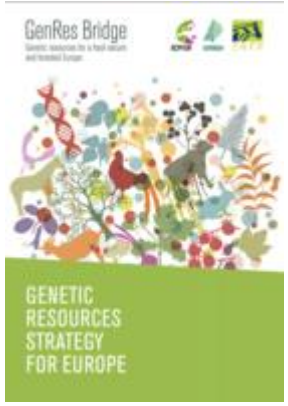
G-Bike - Genomic Biodiversity Knowledge for Resilient Ecosystems https://g-bikegenetics.eu/en



GenRes Bridge - The Genetic Resources Strategy for Europe http://www.genresbridge.eu/