

Role and Objectives of Cryopreservation Programs

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Genetic diversity of farm animals

- Genetic diversity in livestock species declines at a rapid rate
- This is generally seen as a threat
- Countries have taken measures to maintain genetic diversity



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Causes of decline of genetic diversity

- Globalisation in the use of breeds
- Inbreeding in small populations
- Inbreeding also in the large breeds



Why conserve genetic diversity?

Local breeds

- more suited for local conditions of climate and terrain
- product quality for typical regional products and cuisine
- “cultural heritage”
- maintain rural communities

Large and local breeds

- Inbreeding → increased frequency of heritable diseases
- We need genetic diversity as ‘toolbox’ for continued breeding, especially as future breeding goals may be different from those of today

How to conserve genetic diversity ?

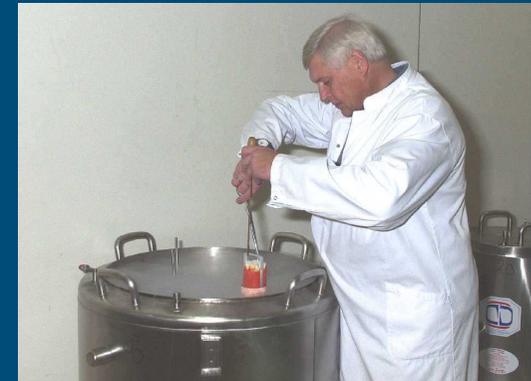
■ *In situ* conservation

- Conservation by utilization
- Adaptation to changing environments
- Sustainable breeding
- Promoting different functions of breeds
- *Exposure to genetic drift*



■ *Ex situ* conservation

- Live (*in vivo*)
- **Cryo storage (in vitro / gene banks)**

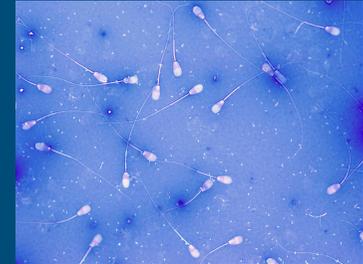


■ *In situ* and *ex situ* are complementary

Purposes of AnGR gene banks

Preserve the present wealth of genetic diversity
→ secure it for future generations

- To be able to recreate lost breeds or breeding lines
- As back-up in case genetic problems would occur
- To allow development of new lines or breeds
- Support *in situ* conservation
- For research



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AnGR and Gene Banks

- To collect, preserve and assess animal genetic resources
- Primary function is the conservation of genetic resources in the near, medium and long term.
- Gene bank collections can be multifaceted in function and objectives
 - Developing multiple functions increases the opportunity for potential returns



Gene Banks and Time

- Gene banks have the responsibility to take the long term view
- What is out of favor can come back in favor
- Cryopreservation in liquid nitrogen (-196 °C)
 - All chemical and physical processes arrested
 - Consequently, storage is safe for a long time

Dual strategy - long term + short term storage

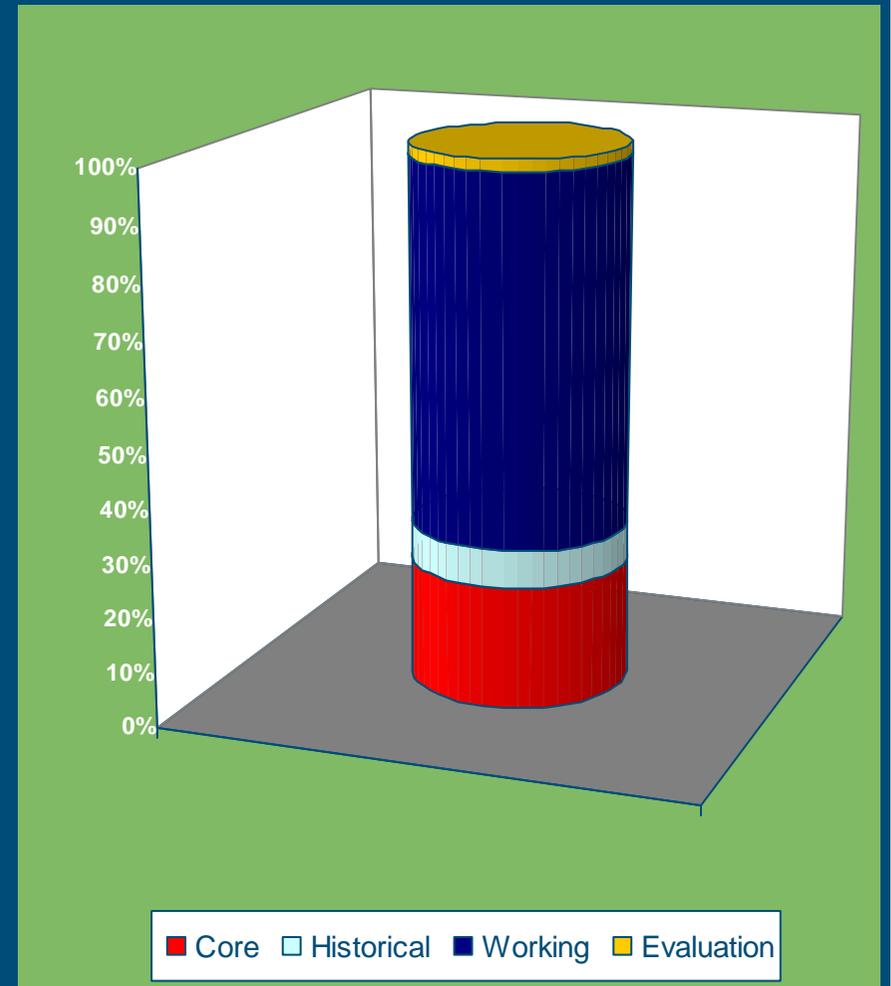
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- Safe and preserve biodiversity 'for eternity'
 - No regular use
 - Updates
 - Actively use the germ plasm
 - To support breeding schemes
 - Regular exchange with *in situ* populations

What to conserve ?

	Semen	Embryos	Somatic cells
Breed reconstruction	Yet, but	Yes	Yes, but
Creation of synthetic breeds	Yes	Poor	Poor
Gene introgression	Yes	Poor	Poor
Cryo aided live scheme	Yes	Poor	Poor

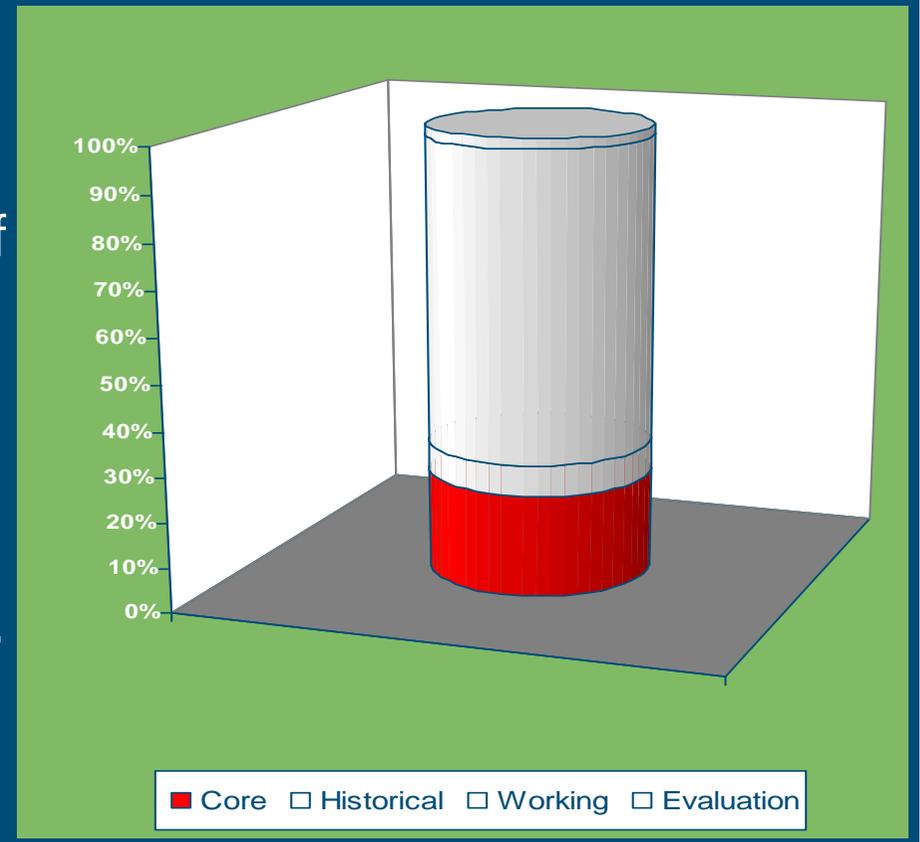
Collection Categories

- With diverse gene bank functions there is a need to have a **multiple tiered collection** for various species and breeds
- Identification of the various tiers facilitates collection development and the potential release of germplasm



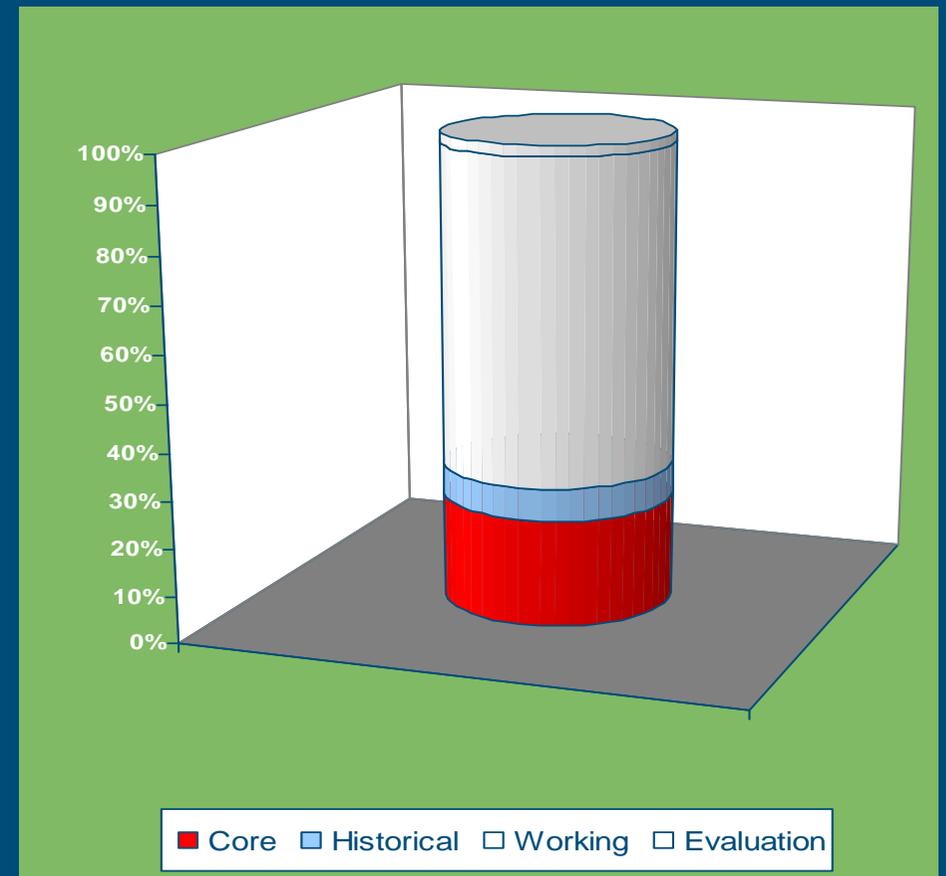
Collection Categories – Core Collection

- Germplasm potentially used in a breed/population critical situation
- Core Collection contains the breadth of breed's genetic diversity (e.g., broad sampling, $N_e = 50$)
- Core Collections at least 150% of that needed to reconstitute the breed
- The Core Collection need not be static, it can be updated to insure the genetics are of utility



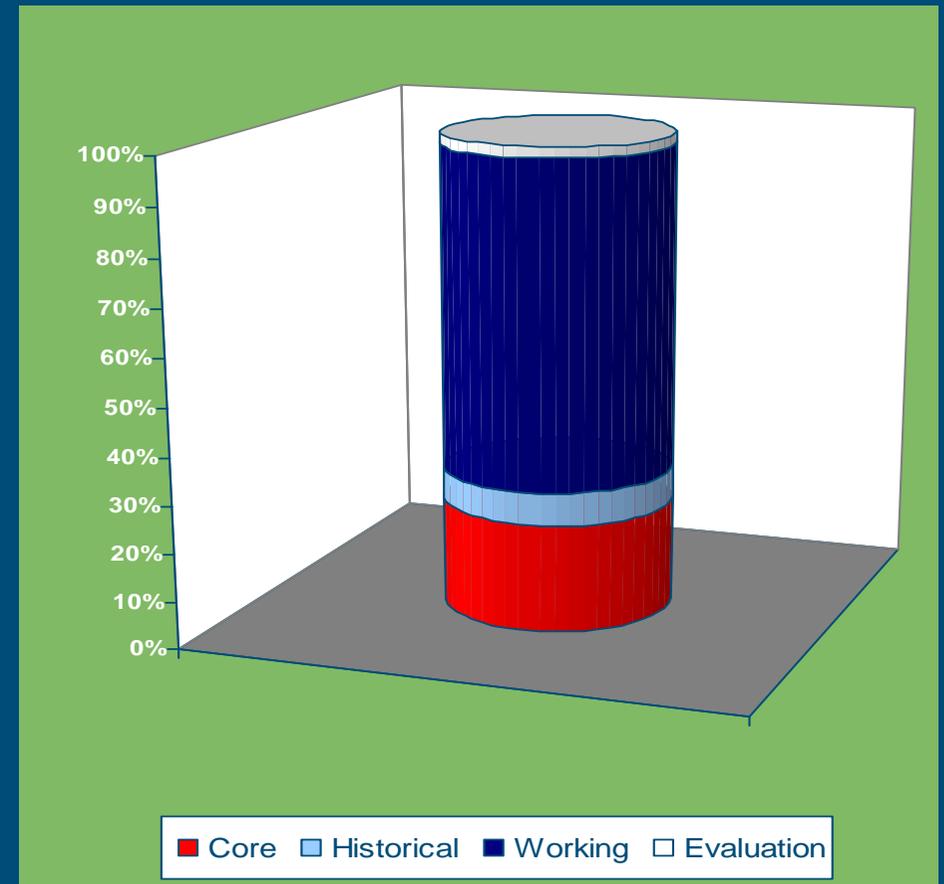
Collection Categories – Historical Collection

- An optional classification, distinct from Core
- Germplasm that has become dated may have lost utility to current breed requirements
- Historic collections of germplasm have been shown to have utility as a DNA source



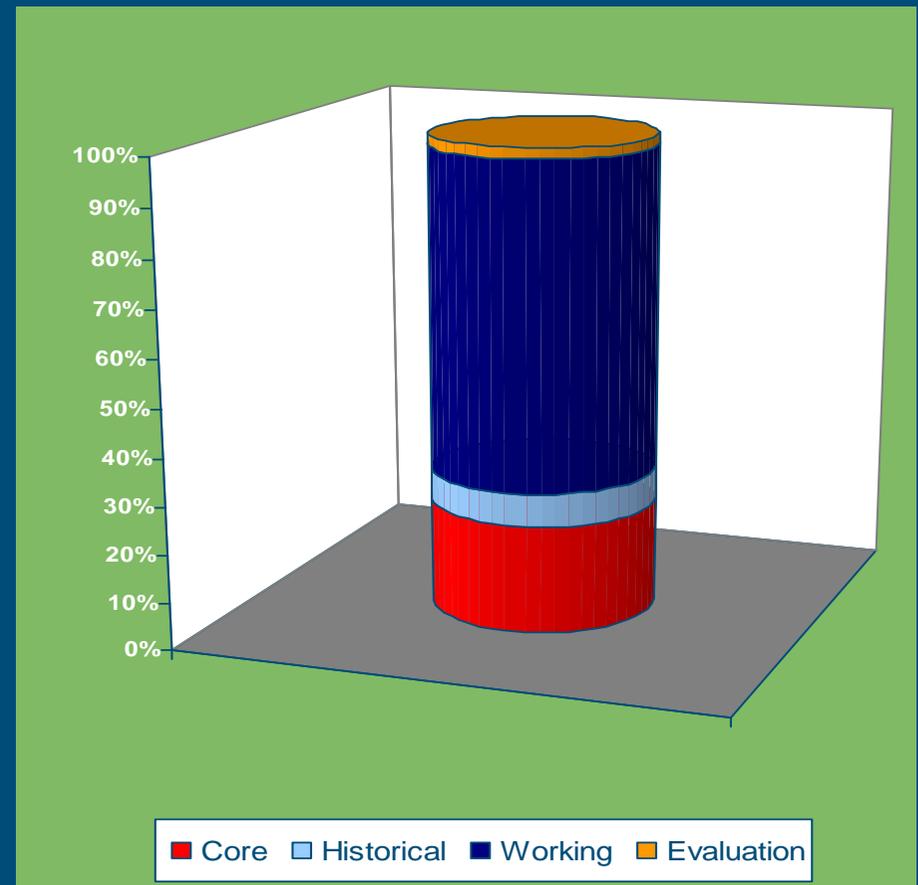
Collection Categories – Working Collection

- Provides ready access to relevant germplasm for:
 - Cryo-aided breeding and conservation schemes
 - Potential development of research populations of animals
 - A source of unique germplasm if a breed should change selection goals
 - Eliminate a deleterious allele
 - Be used in developing a new breed
- Germplasm quantities may be quite large



Collection Categories – Evaluation Collection

- Germplasm in this category is used to evaluate
 - the viability of cryopreserved germplasm
 - the sanitary status of the germplasm
- Tests can be performed at various times e.g., after freezing and if there is a concern that the samples were compromised in some fashion
- For each animal a relatively small number of straws are used (eg, 2 to 10 straws of semen)



Collection Categories – Restricted Collection

- Repositories may not have “free use” to some germplasm which the owner wants to protect from potential competitors
- The Restricted Collection allows the gene bank to acquire the material for potential future use

Minimum requirements for the Core collection

- Must allow recovery of a lost breed or breeding line
- Software tools to decide on breadth of sampling (N_e) and numbers of samples needed (e.g. Conservation planner) will be discussed elsewhere in this course.
- Numbers of samples needed per male or female depends on type of germplasm (e.g. semen, or embryos).
- For semen, as a 'rule of thumb' one may assume that 400 semen doses of 25 males must be preserved for a recovery of the breed by backcrossing in 7 generations.

Conclusions

- Developing collections for multiple purposes
- Developing the structure and targeted goals of the collection effective guides the collection process
- Gene bank development is a long term prospect in terms of development and use