How can cryopreserved genetic resources be used in domestic animal populations ?

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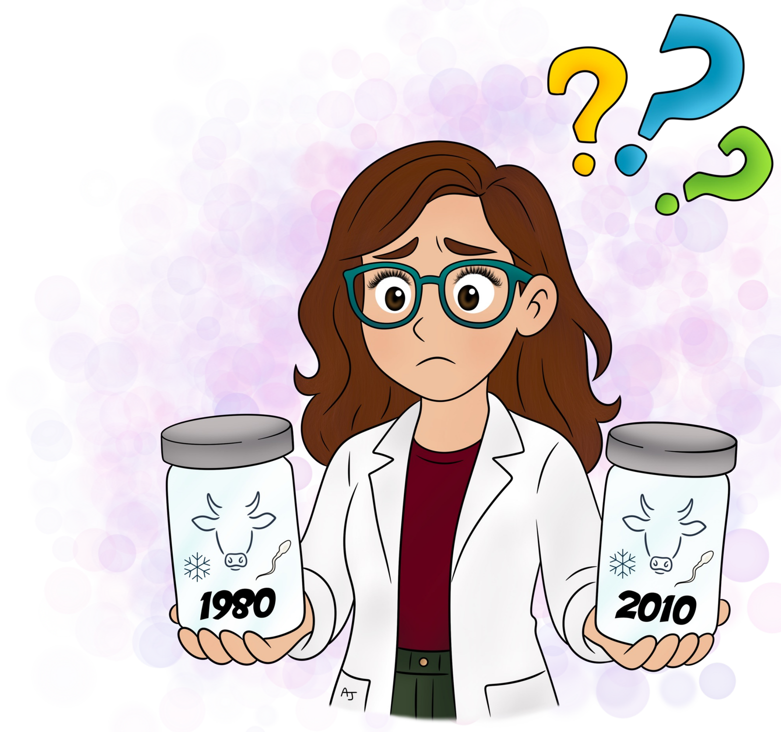
CONTEXT



Genetic diversity is essential for the sustainability and adaptability of populations and is therefore a cornerstone of agro-ecological transition. Yet, closed populations inevitably see their genetic variability erode over time, driven by selection and/or genetic drift. Preserving the genetic diversity of animal populations is therefore a race against time, and efforts must be made as much as possible.

The use of cryopreserved genetic resources, available in cryobanks, could be a valuable tool to help manage populations, but unfortunately these resources are still very little used today.

So, how can these frozen treasures be mobilized to support diverse populations ? And what best practices should guide their use ?

METHOD

- Population simulations using MoBPS (Modular Breeding Program Simulator, Pook et al. 2020)
- Simulation of two traits, Trait 1 and Trait 2, with a heritability of 0.4 and a negative genetic correlation of -0.3
- For selected population, reproductive individuals are selected from a synthetic index combining the estimated breeding values of the two traits, using a weight of 0.8 for Trait 1 and a weight of 0.2 for Trait 2
- A scenario with a "strong" change in breeding goals was also simulated for selected populations, with a weight of 0.2 for Trait 1 and a weight of 0.8 for Trait 2
- Four types of scenarios that differed in the selection process used :

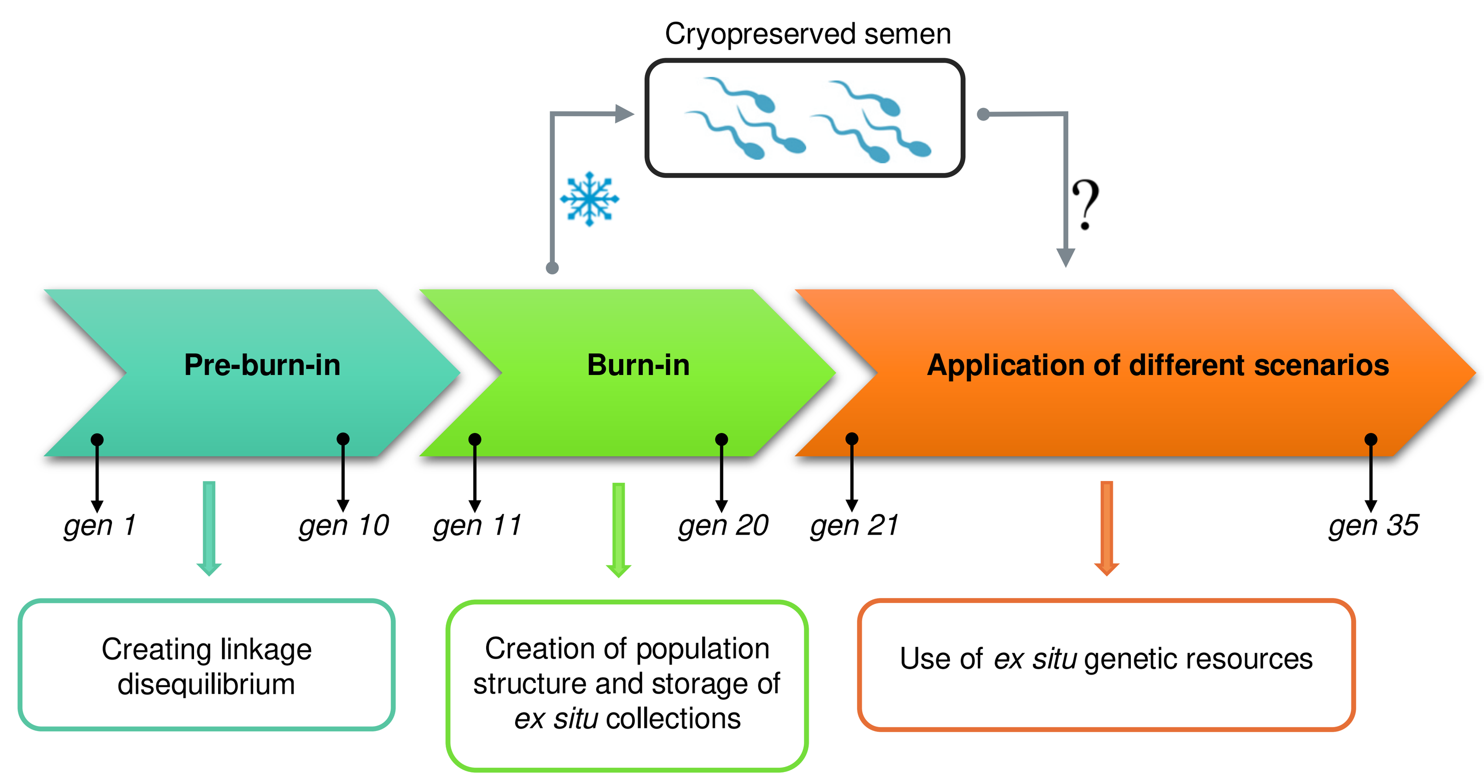
  rm → random choice of parents among the candidates

  max_GD → a choice of parents that minimizes the loss of genetic diversity

  OCS → a choice of parents that maximizes genetic gain under the constraint of a maximal increase in kinship of 0.5% per generation

  max_BV → choice of parents that maximizes genetic gain on a synthetic index combining both traits

- Scenarios tested with or without the use of cryopreserved collections

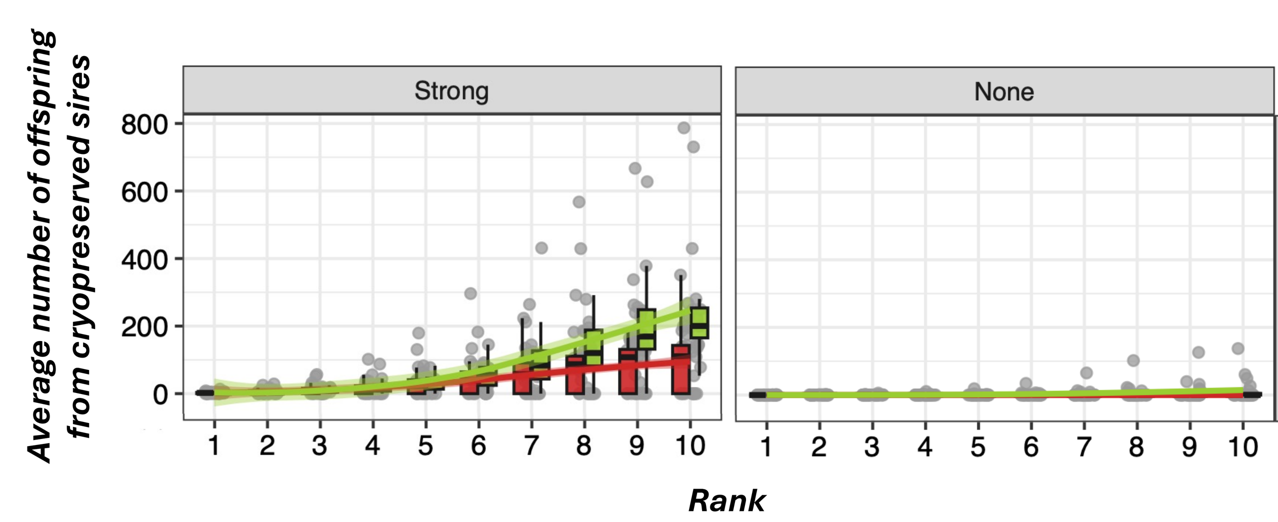


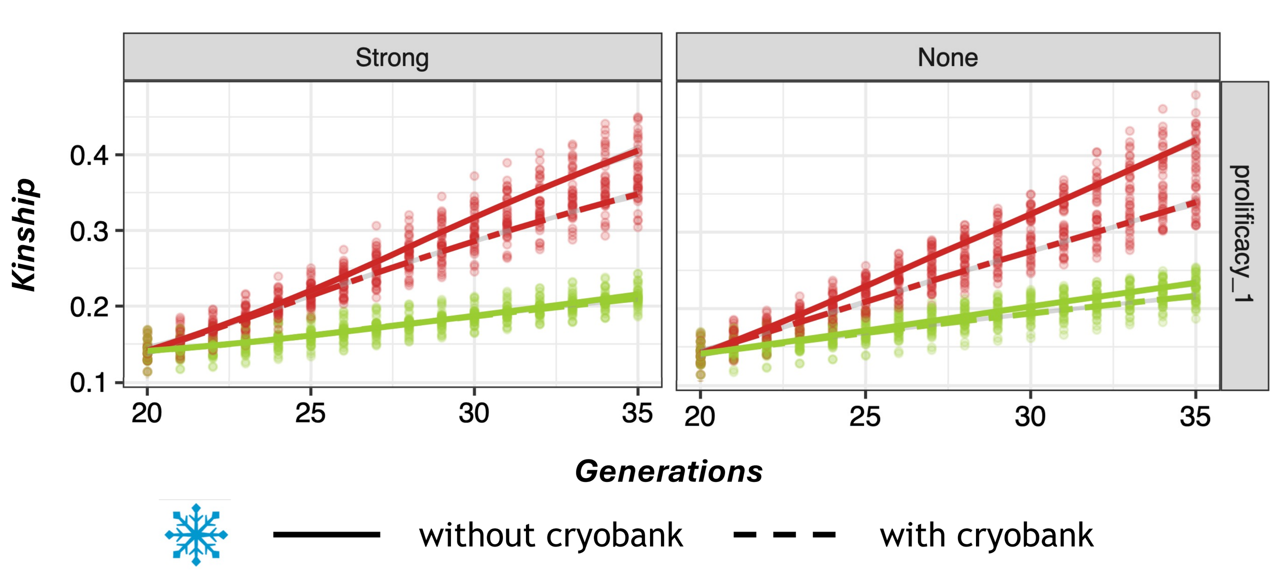
RESULTS

- **USE OF CRYOPRESERVED INDIVIDUALS**

  → For selected populations (max_BV and OCS scenarios), punctual introduction of a few cryopreserved individuals (especially without changing the breeding goal) with their progeny conserved in the breeding scheme after several generations

  → For populations under a conservation program (max_GD and rm scenarios), widely used genetic resources





- **IMPACT ON GENETIC DIVERSITY**

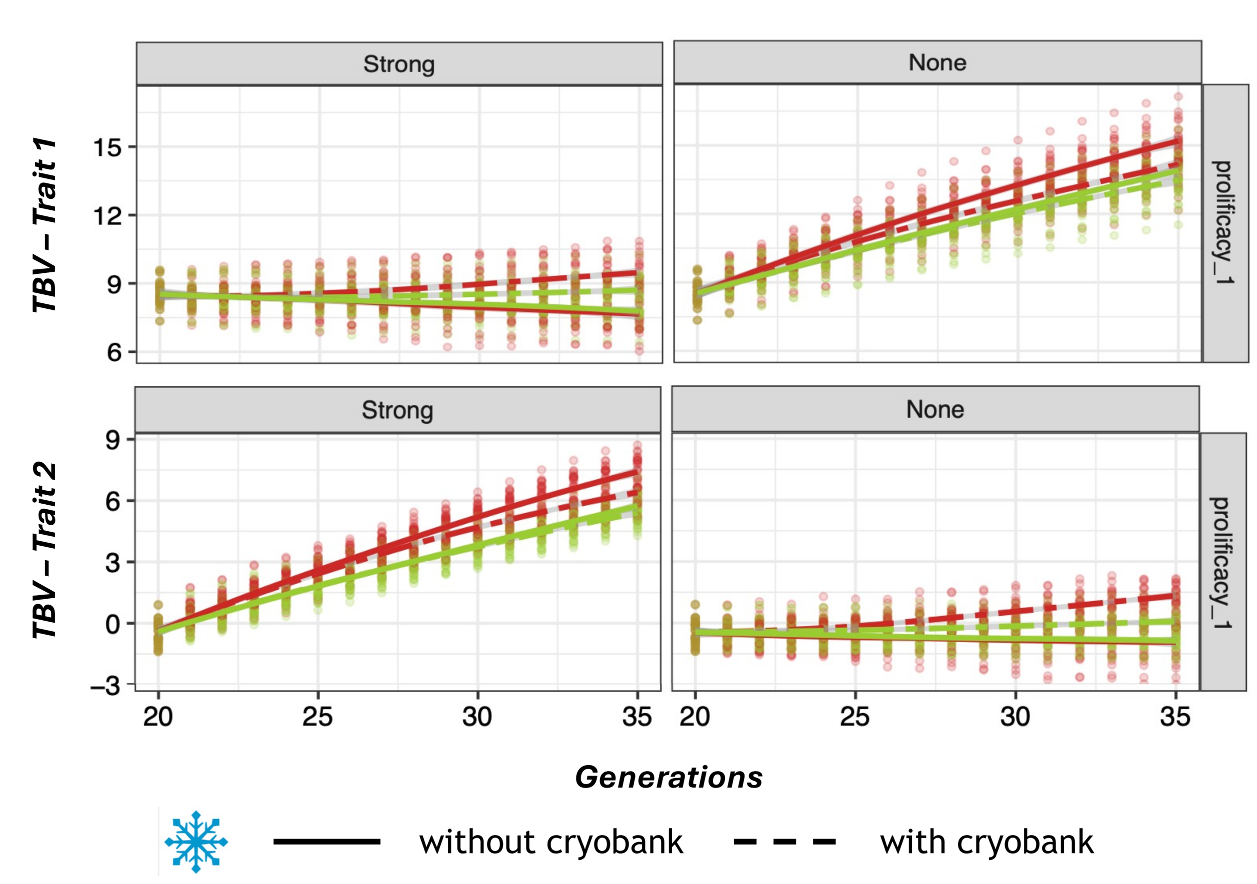
  → For selected populations (max_BV and OCS scenarios), slower loss of diversity, but more moderate in the case of OCS (already very effective at limiting the erosion of variability as soon as it is applied)

  → For populations under a conservation program (max_GD and rm scenarios), reduced loss of genetic diversity

- **IMPACT ON BREEDING VALUES**

  → Only for selected populations (max_BV and OCS scenarios), the synthetic index is not impacted, but individual trait behaviors vary according to the intensity of the change in breeding goal.

  With no change of objective, Trait 2 is less degraded, while with a change of objective, Trait 1 is preserved, and Trait 2 is little degraded (or not at all in the case of OCS).



CONCLUSION

Cryopreserved material emerges as an effective means of managing the genetic variability of animal populations — whether to slow the erosion of diversity or to redirect breeding goals. However, for populations under selection, caution is key: the reintroduction of old genetic material could create disadvantages, with a gap in breeding values for selected traits of interest. Finally, our study also highlights a crucial point — cryobank collections must contain sufficiently large stocks (*e.g.*, number of sires and straws) to unlock their full potential and ensure truly efficient use.

For more details, please check the full published article at the following link : https://doi.org/10.1111/jbg.70000

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