Cryoconservation of genetic resources of the native sheep and goat breeds in Finland

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Who are we?

Natural Resources Institute Finland (Luke):

- Professor, PhD **Juha Kantanen**: Finnish national coordinator of AnGR, genomics
- Principal Scientist, PhD **Jaana Peippo**: PI of Biobanking at Luke, ARTs, genomics
- Senior Scientist, DVM, PhD **Heli Lindeberg**: ARTs
- Researcher, MSc **Petra Tuunainen**: PhD student
- Technical expert, MSc **Mervi Mutikainen**: ARTs
- Technical expert **Tuula-Marjatta Hamama**: ARTs, genomics

Lammasmaailma Oy:

- DVM **Johanna Rautiainen**: Sheep and goat specialist in Finland

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- The preservation, conservation and sustainable use of the genetic resources of agricultural plants and animals are regulated by **Finland's National Genetic Resources Programme for Agriculture, Forestry and Fishery (2018)**, which is based on international agreements, frameworks and action plans.
- The animal genetic resources programme aims to secure **the national genetic resources of domestic animals (horse, chicken, dog, sheep, bee, cattle, reindeer, pig and goat)** for the present and future agricultural and food production and other uses. This is done through analyses and inventories, sustainable utilisation and conservation of local breeds, and participation in national and international expert work. Promoting communication and research is also important. Diverse animal genetic resources are an absolute necessity for the breeding of domestic animals and the research and development work related to this.
- In Finland, **the Natural Resources Institute coordinates the plant and animal genetic resources programmes** and **collaborates with NordGen** that operates under the Nordic Council of Ministers. The Natural Resources Institute Finland also participates in regional cooperation in Europe. The objectives of the National Genetic Resources Programme are also promoted through measures and funding under the Common Agricultural Policy of the EU.

Traditionally focus has been on *in situ* conservation of AnGR

In situ conservation is important

- Genotype × environment interactions are crucial for the adaptation of breeds
- Genetic diversity of farm animals is crucial for the future food security
- Appreciation of the local Nordic food culture

➢ Living populations are, however, vulnerable for internal and external threads such as inbreeding and disease outbreaks

Should we be worried about our AnGR?

- All our native breeds except for the Finnsheep and trotting/riding Finnhorse lines are threatened
- There is currently no accurate information about the number of individuals in these small populations – the situation can change dramatically and quickly!

Cryoconservation (*ex situ*) supports *in situ* conservation

Cryoconservation status in Nordic countries

- Semen — All countries
- Oocytes — None
- Embryos — Denmark, Finland, Norway
- DNA, somatic cells and various tissues — Finland, Norway, Sweden

	Cattle	Sheep	Goat	Horse	Pig	Dog	Poultry	Fish	Honeybee
Denmark	✓	✓	✓	✓	✓		✓		
Faroe Islands	✓	✓	✓						
Finland	✓	✓	✓	✓		✓	✓	✓	✓
Iceland	✓	✓	✓						
Norway	✓	✓	✓				✓	✓	✓
Sweden	✓	✓	✓	✓	✓	✓			

Selection of donors for national gene banks: national coordinators with the aid of relevant breed associations

Cryoconservation is considered expensive: optimisation of cost-effective sampling for cryoconservation of AnGR

Traditional methods:

- Ejaculated semen collections at the certified AI stations
- Embryo collections from living donors following hormonal stimulations

Cost-effective methods:

- Epididymal sperm collections following removal of testis after slaughter or castration
- Embryo production in laboratory

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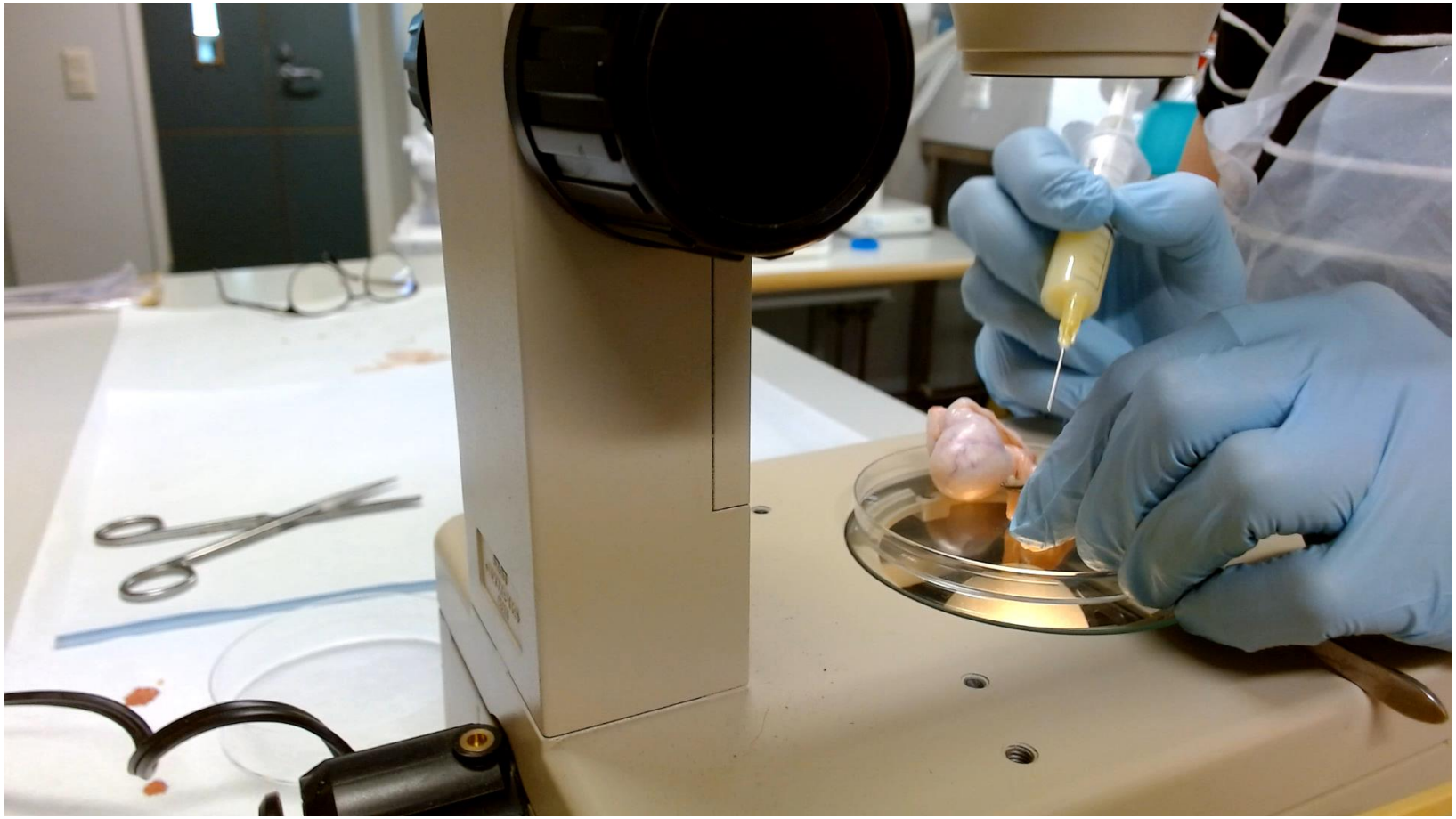
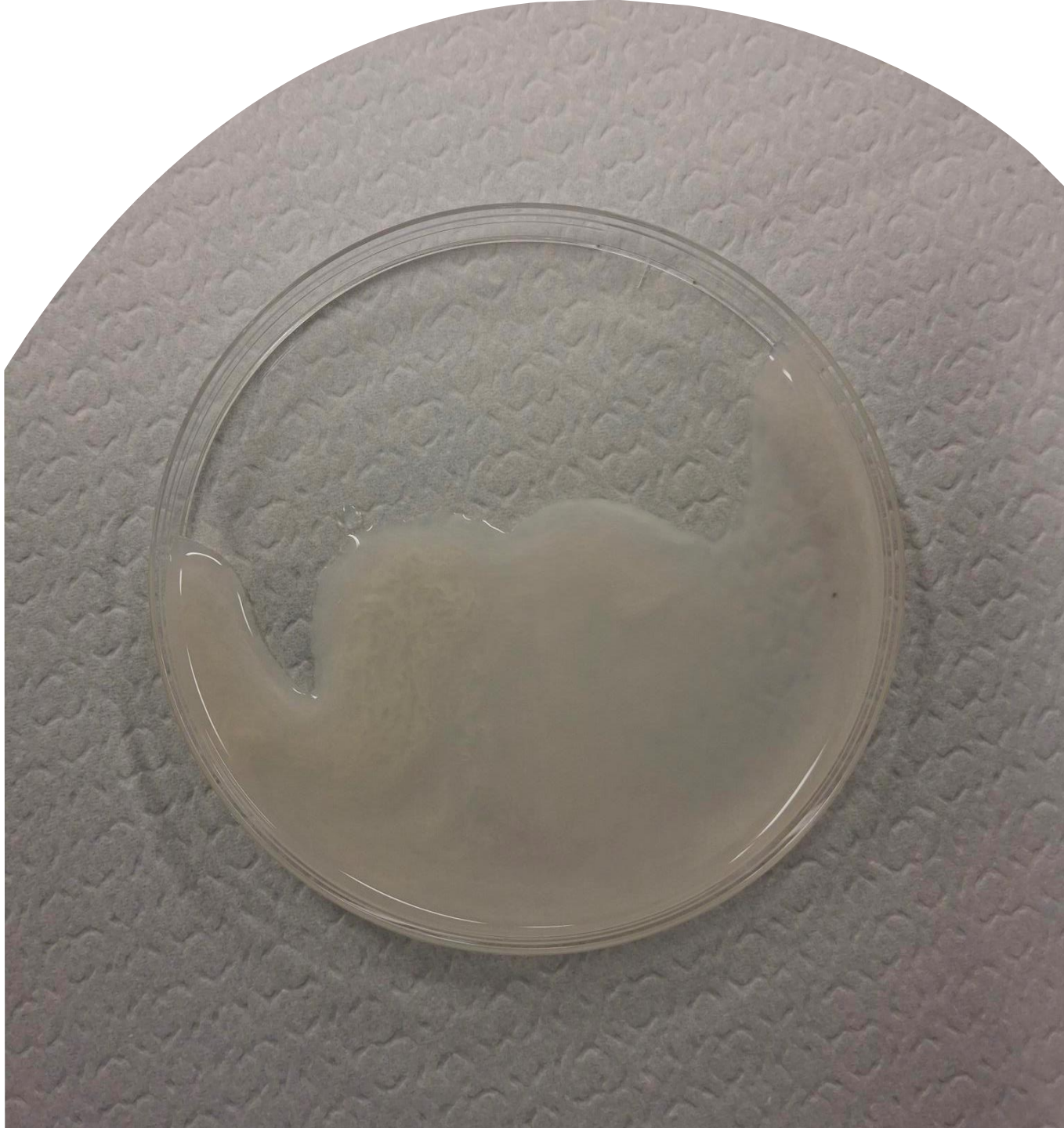
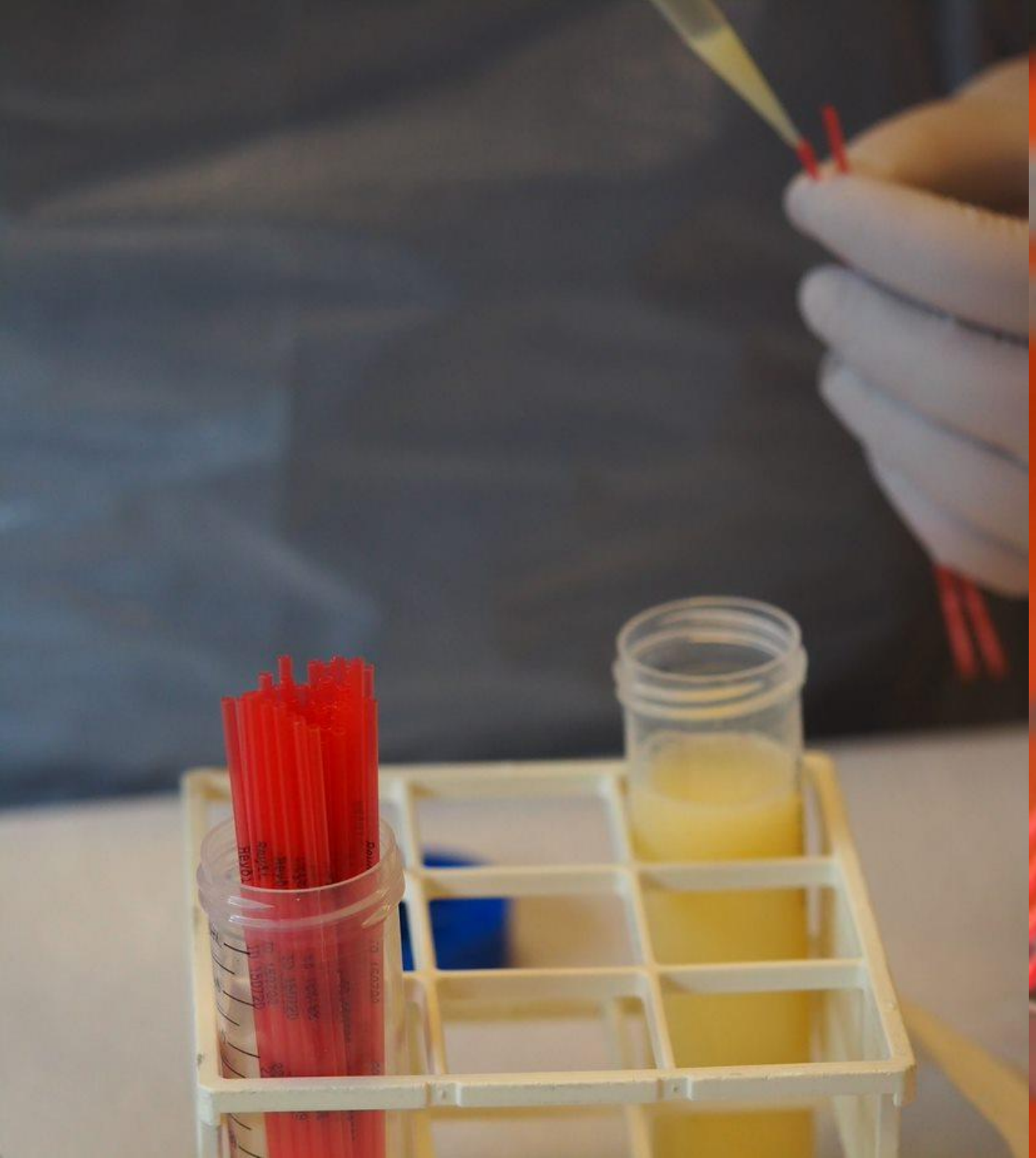
Collection of epididymal bull sperm



Fresh epididymal ram sperm





Ejaculated semen or epididymal sperm?

Ejaculated semen:

- Expensive infrastructure at certified AI stations
- Few donors
  - Breeding schemes
  - Genetic diversity ↓
- Repeated collections
  - Large number of doses
  - X and Y sorted semen
- Sanitary status of donors is already well defined

Epididymal sperm:

- Cheap infrastructure
- Many donors
  - Conservation schemes
  - Genetic diversity↑
- Single collection
  - Limited number of doses
- Sanitary status of donors needs to be defined before collection

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STROEBECH SMALL RUMINANT MEDIA

Slaughterhouse ovaries

N_2

Aspiration of follicles

Spermatozoa from selected bucks / rams

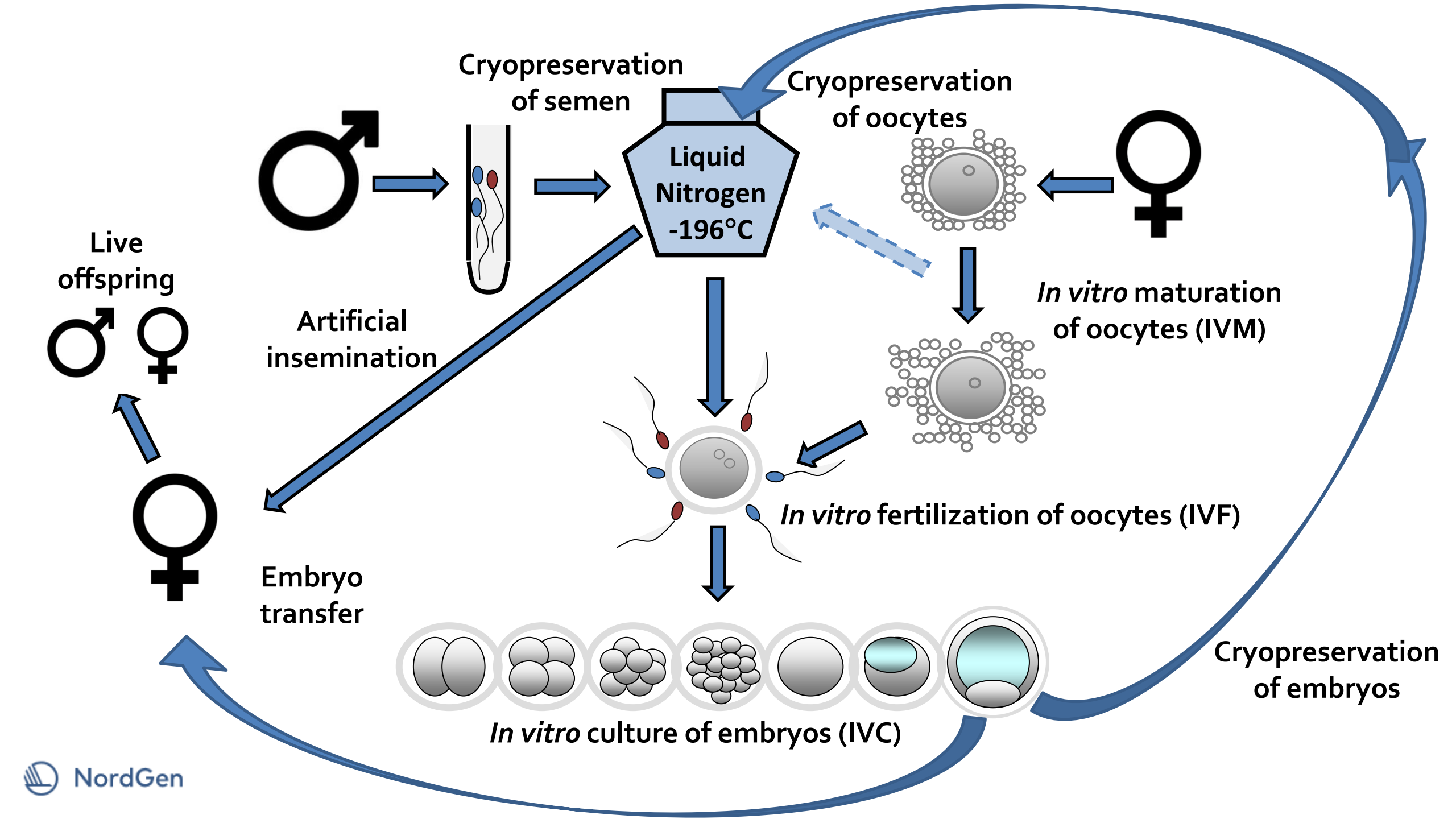
In vitro maturation of oocytes

In vitro fertilization

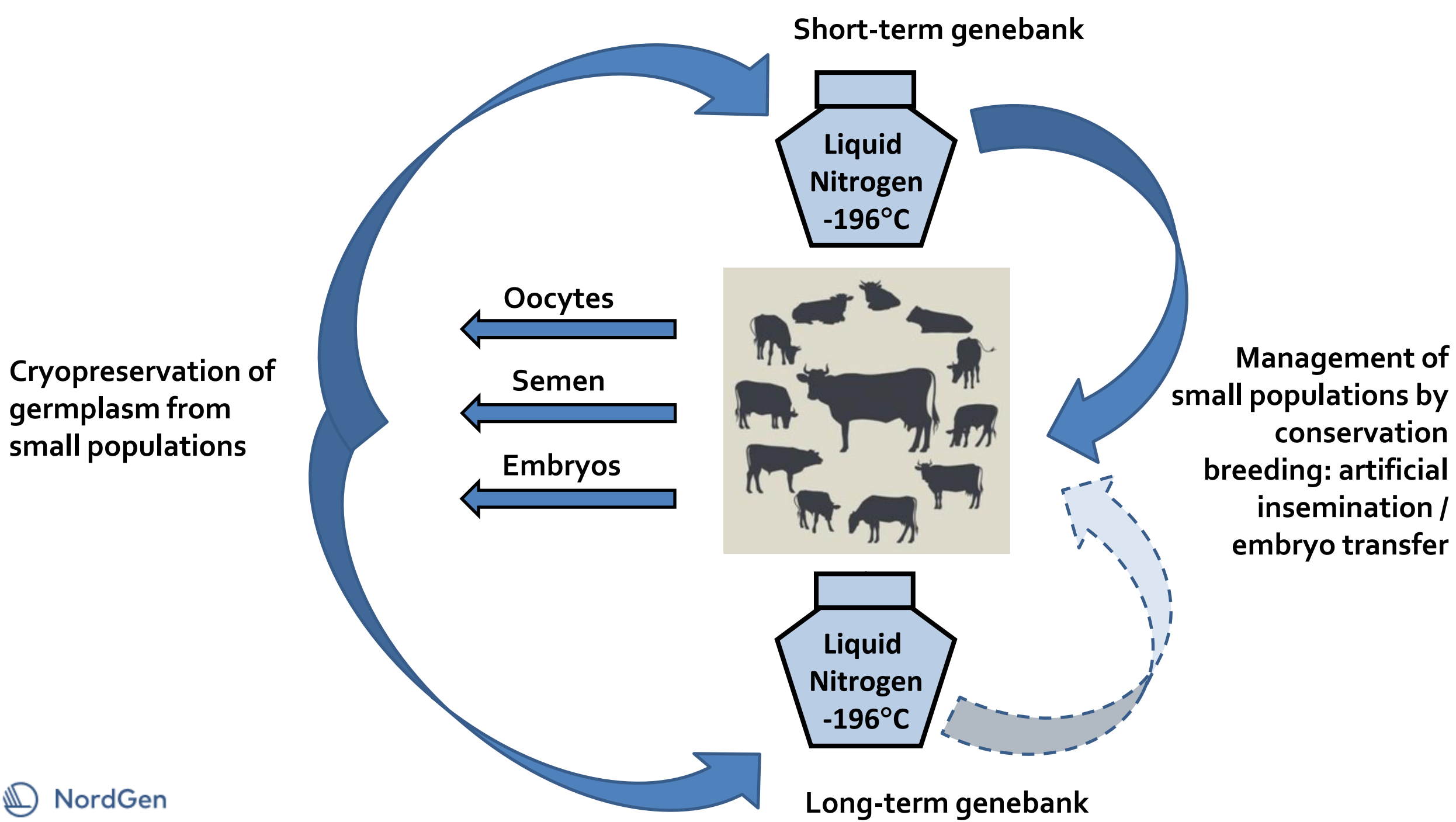
1 x 10^6 spermatozoa / ml

In vitro culture

Photo.:Tuula-Marjatta Hamama


Cryopreservation of semen
Liquid Nitrogen -196°C
Cryopreservation of oocytes
Live offspring
Artificial insemination
In vitro maturation of oocytes (IVM)
In vitro fertilization of oocytes (IVF)
Embryo transfer
In vitro culture of embryos (IVC)
Cryopreservation of embryos

NordGen

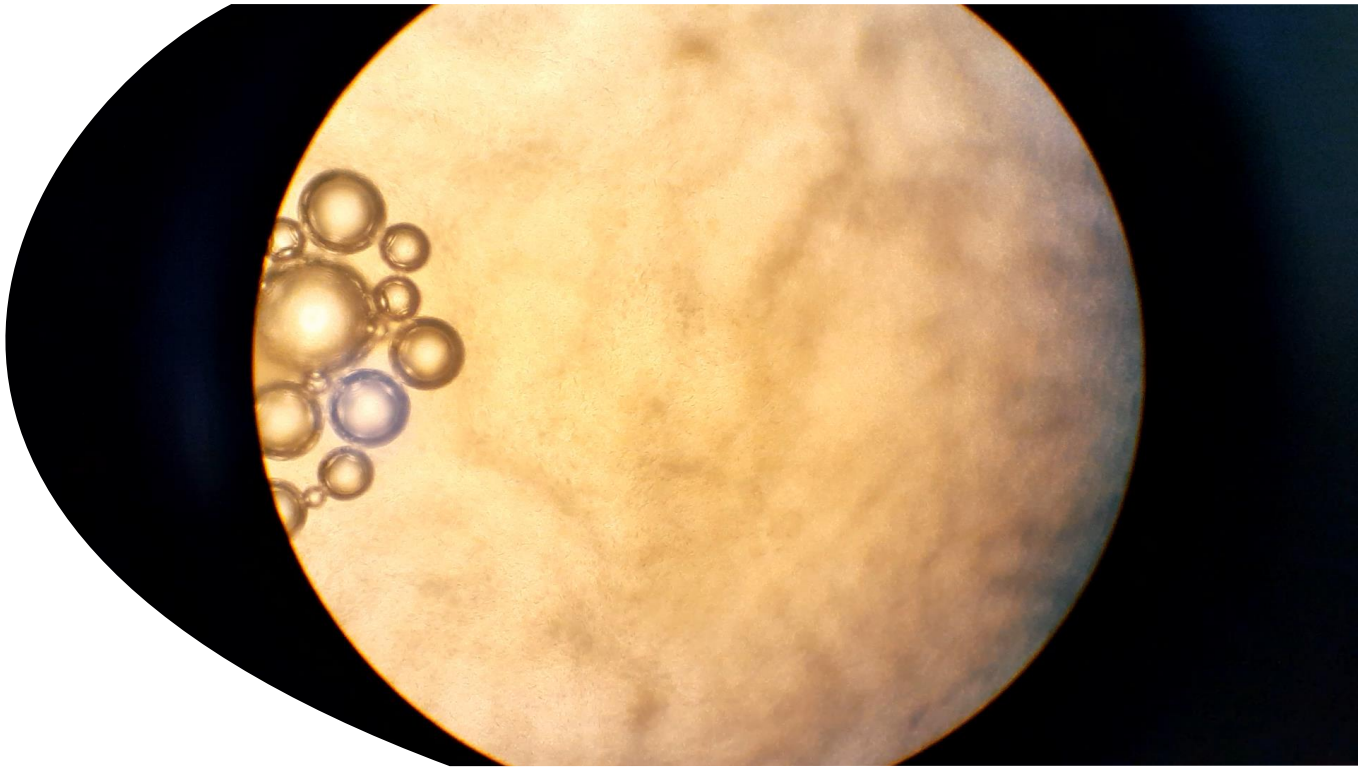

Short-term genebank
Liquid Nitrogen -196°C
Oocytes
Semen
Embryos
Cryopreservation of germplasm from small populations
Management of small populations by conservation breeding: artificial insemination / embryo transfer
Liquid Nitrogen -196°C
Long-term genebank

NordGen

Finngoat

Photo: Luke archives

Finngoat semen doses from 11 bucks (36-195)

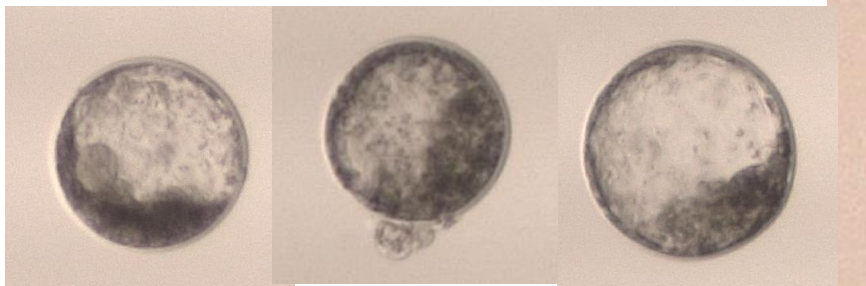


Video: Heli Lindeberg

Our very first Finngoat IVP embryos

Total of four embryos from

- 2 bucks
- 3 ewes



Photos: Mervi Mutikainen

Finnsheep

Photo: Luke archives

Kainuu Gray

Photo: Luke archives

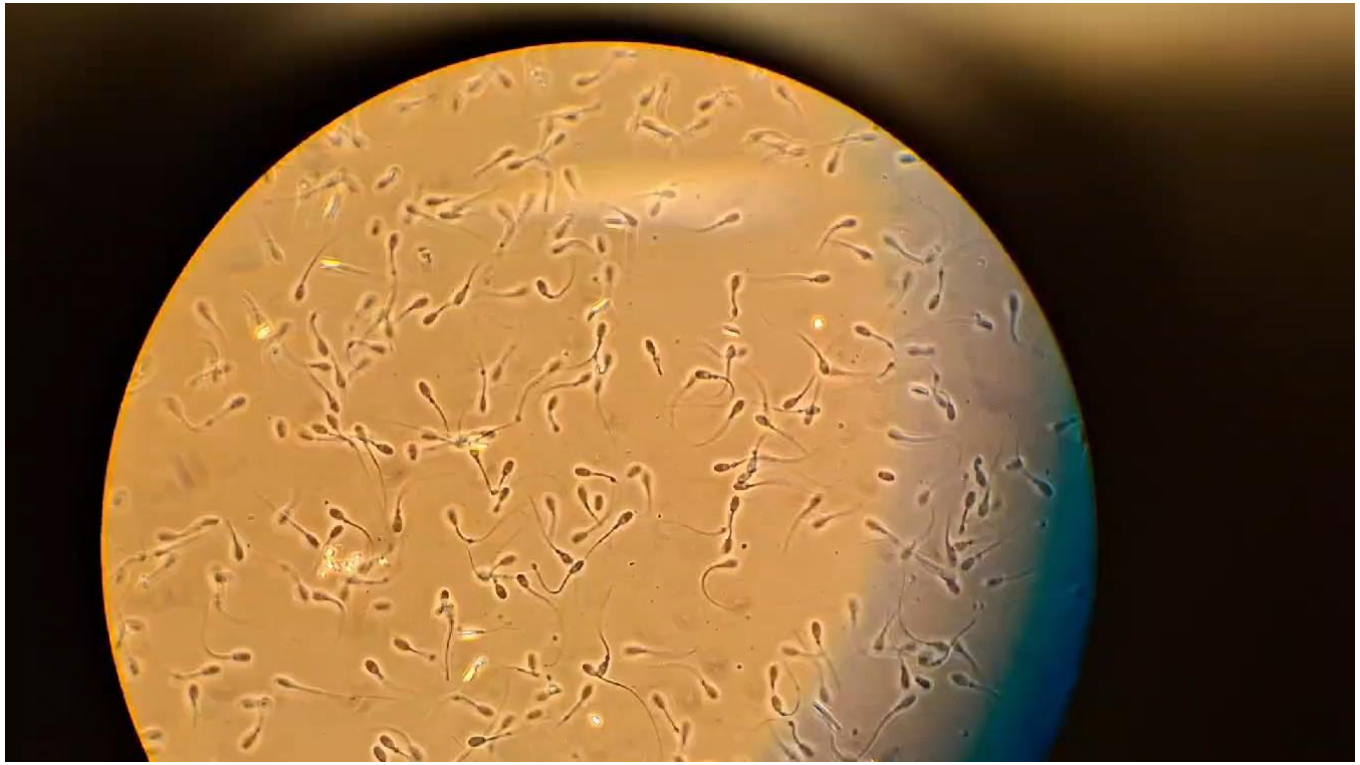
Åland sheep

Photo: Kairan Tapulin tila

Finnsheep semen doses (n = 82)

Finnsheep	55
Åland sheep	11
Kainuu Grey	16

Our very first ram epididymal sperm collection and cryopreservation



Finnsheep

Total of 190 embryos from

- 20 rams
- 62 ewes

Photo: Mervi Mutikainen

Reindeer

Total of 11 embryos

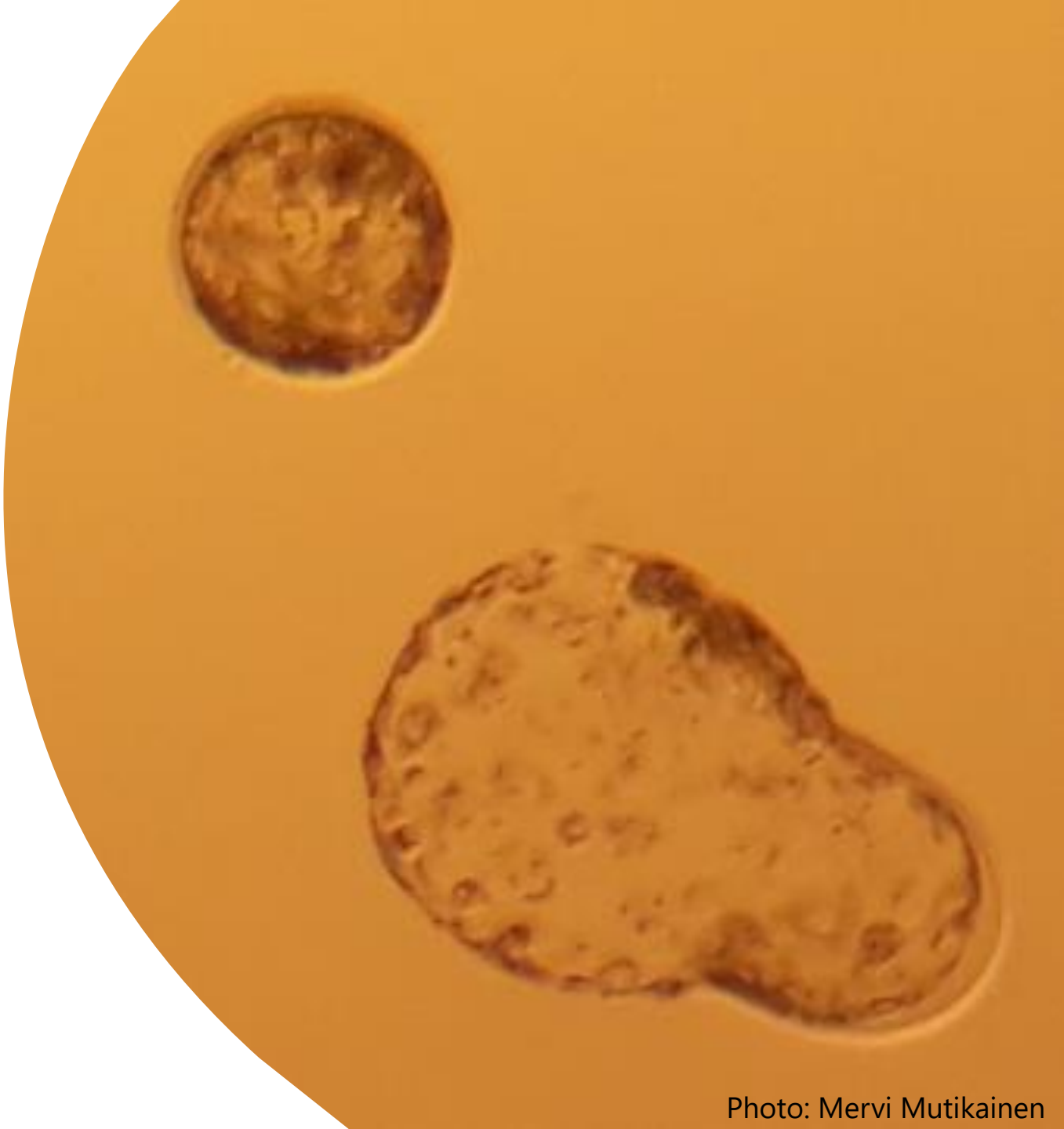


Photo: Mervi Mutikainen

Future research topics

Epididymal sperm quality assessments

AI in small ruminants

Non-surgical embryo transfer in small ruminants

Thank you for your attention!