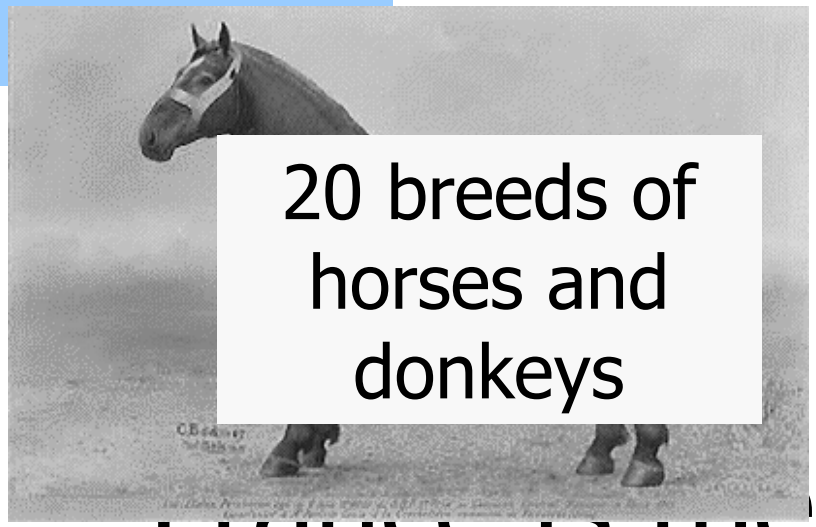
CRYOBANQUE NATIONALE

The French Cryobank of biological material as safe ex-situ conservation

C. Danchin-Burge
INRA - UMR GABI / Institut de l'Elevage
France

CRYOBANQUE NATIONALE

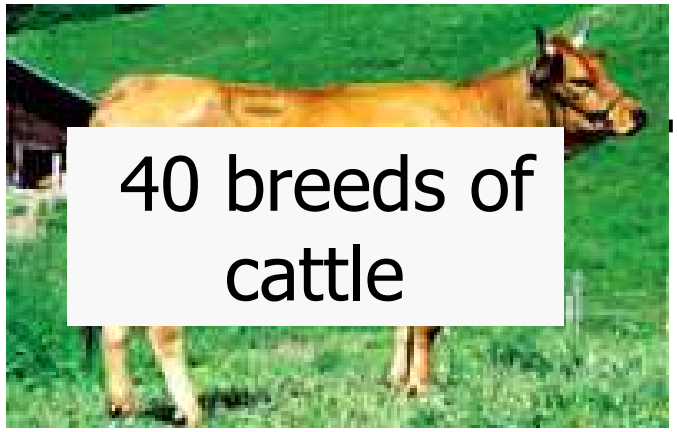


20 breeds of horses and donkeys

10 breeds of goat

France is the land of a rich livestock

50 breeds of sheep



40 breeds of cattle

Etc.

… in theory !

CRYOBANQUE NATIONALE

=> Impoverishment of the breeds biodiversity

2 breeds represent 99% of the goat population
3 breeds represent 75% of the cattle population
… etc.

=> Impoverishment of the within breed genetic variability

Example : French Holstein cattle breed

2 millions cows => genetic diversity equivalent of 43 animals !

With *in-situ* programs, cryoconservation is a complementary way to preserve farm animal diversity

CRYOBANQUE NATIONALE

The French national Cryobank

12 partners

CRYOBANQUE NATIONALE

FRB

INSTITUT DE L'ELEVAGE

Ministère de l'agriculture de l'alimentation de la pêche et des affaires rurales

ITAVI

SYSAAF

INRA

Institut National de la Recherche Agronomique

Races de France

UNCEIA

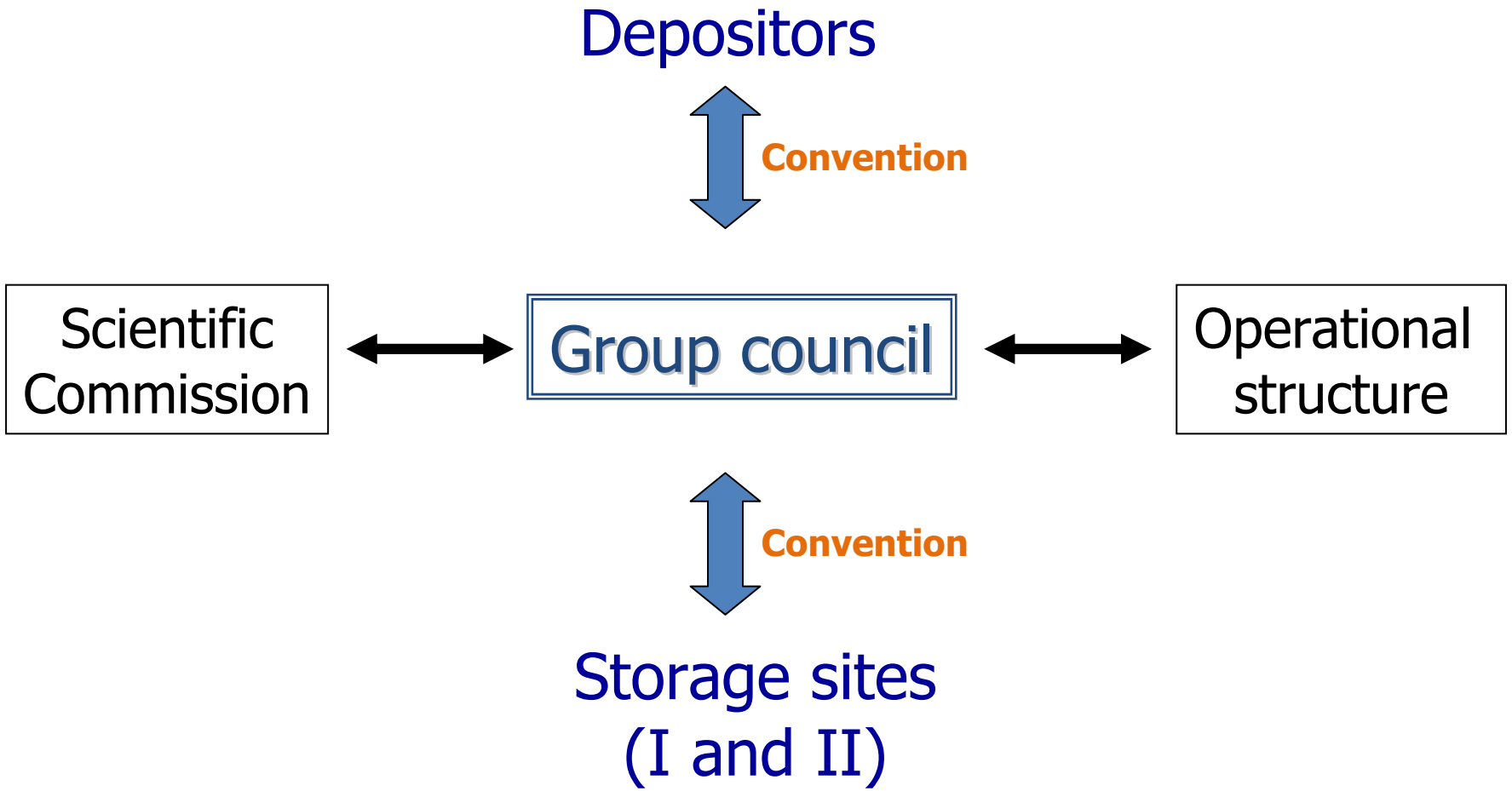
ifip institut du porc

les Haras nationaux

Ifremer

Organization of the French Cryobank

CRYOBANQUE NATIONALE



What can you find in the collection ?

CRYOBANQUE NATIONALE

- **Goal = 9 livestock species**
- **Type of Biological Material:**
  - ✓ Semen (++++)
  - ✓ Embryos (++)
  - ✓ Cells (+)
  - ✓ DNA (0)
  - ✓ Serum (0)
- **Improved Animal Populations (breeds, strains...)**
- **Categorized in three types of genetic variability**

Rules of Management

CRYOBANQUE NATIONALE

- Depositor / Cryobank convention
- Group Council decides on what biological material can be put in or taken out of the Cryobank
- Depositor keeps its ownership but leaves the collection management to the Group Council
- To use a sample, the depositor's agreement is mandatory

CRYOBANQUE NATIONALE

Sampling strategies

CRYOBANQUE NATIONALE

Rare breeds

Type I

Exceptional animals not used as breeders

Type II

Improved breeds

Selected breeding stock

Type III

"Type I" material

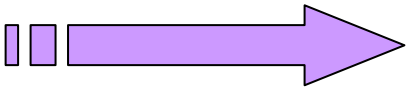
CRYOBANQUE NATIONALE

- **Aim :**

To reconstruct a breed (extinction or loss of a substantial number of animals)

- **Constraints :**

- Technical : success rate of AI / ET
- Effective size: minimum number of animals to reconstruct



25 unrelated males

Example cattle: 800 doses / male

Or 600 embryos

Cf. Ollivier et Renard, 1995

"Type II" material

CRYOBANQUE NATIONALE

Animal exceptional by one or several traits but not used as a breeder

- Exceptional by a production / functional trait
- Exceptional by its pedigree
- Exceptional by its genotype

"Type III" material

CRYOBANQUE NATIONALE

- A breed "snapshot"
  - Sampled on its average generation interval
  - Allows a "live" measure of a breed genetic improvement
  - Allows a "live" measure of correlated traits that are selected *(against or positively)* with an improved trait

What animals are sampled, by type ?

CRYOBANQUE NATIONALE

Type I — Animals as diverse as possible

Goal: preserve the maximum genetic variability possible of a breed

Type II — Extreme and/or original genotypes

Goal: preserve rare genotypes within/between breeds

Type III — Representative of the population

Goal: preserve an accurate "picture" of a breed for a given period of time

What are the potential uses of the material?

CRYOBANQUE NATIONALE

Type I	**1. Help for in situ management**
	2. Restoration of an extinct population
Type II	**1. Change of genetic goals**
	2. Research
Type III	1. “In situ” analysis of the genetic improvement of a population
	2. Change of genetic goals
	3. Research

Focus: sampling procedure in dairy cattle

CRYOBANQUE NATIONALE

TYPE II: bulls semen
- progeny tested
- non commercialized

Yearly sampling / breed
(between 10 to 650 males tested/year/breed)

200 doses / male, on 2 sites

TYPE III: bulls semen
- progeny tested
- commercialized

Yearly sampling / breed
100 doses / male, on 2 sites

TYPE II.1
Original / Extreme EBVs

CRYOBANQUE NATIONALE

Based on Estimated Breeding Value

Reproduction and functional traits

Longevity
Fertility
Cells counts
Morphologic Synthesis

EBV > + 2 s

Production

Milk, Protein, Fat

EBV > + 3 s or < - 3 s

TYPE II.2 : Rare pedigrees

CRYOBANQUE NATIONALE

For a given year t:
1 son of each bull sire without commercialized son

A male stored in the Cryobank for a given year t for a rare pedigree is eliminated if at least one of his half-sib is commercialized the following years

Nowadays, it is more about saving paternal line than saving original strains… it is already too late !

CRYOBANQUE NATIONALE

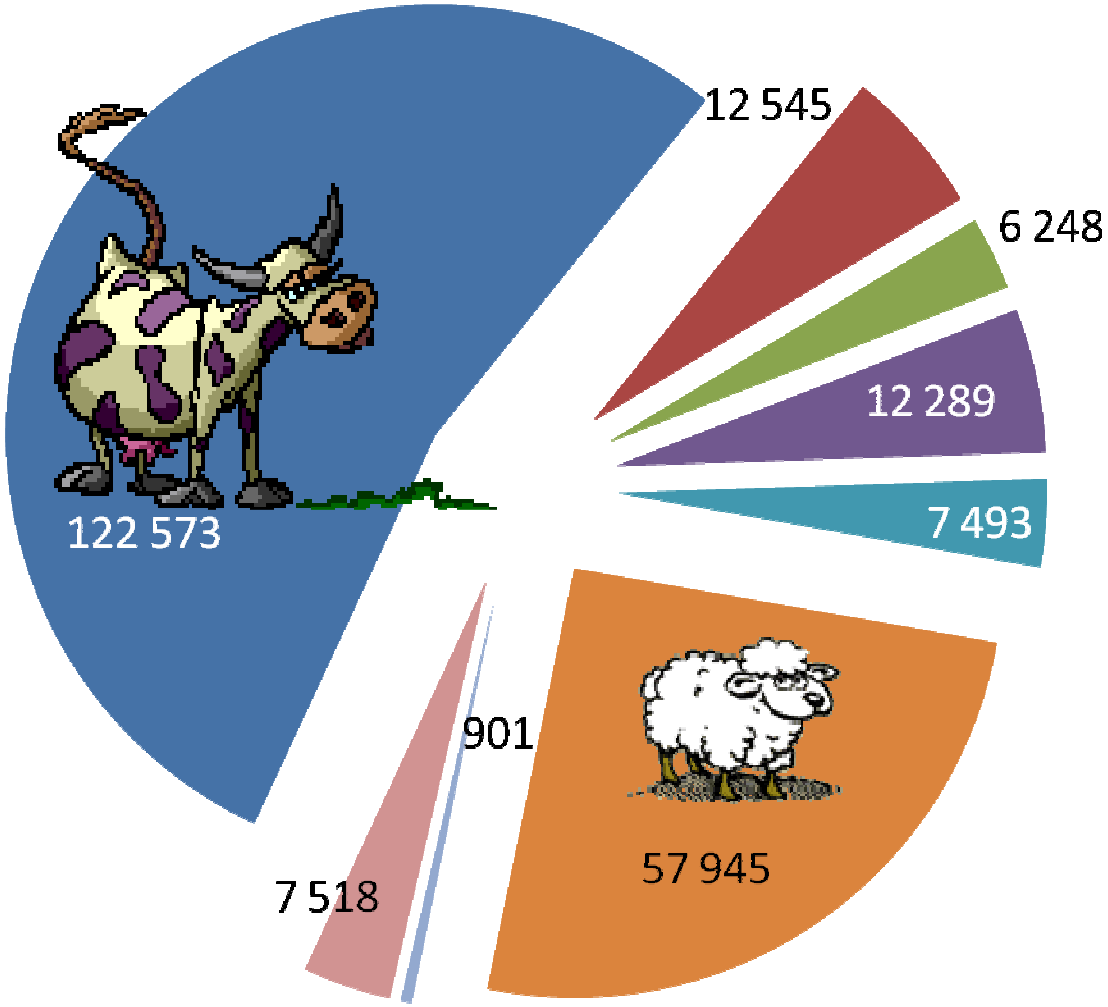
The French cryocollection

www.cryobanque.org

Collection - 2010 update

Number of doses

CRYOBANQUE NATIONALE



Number of doses:

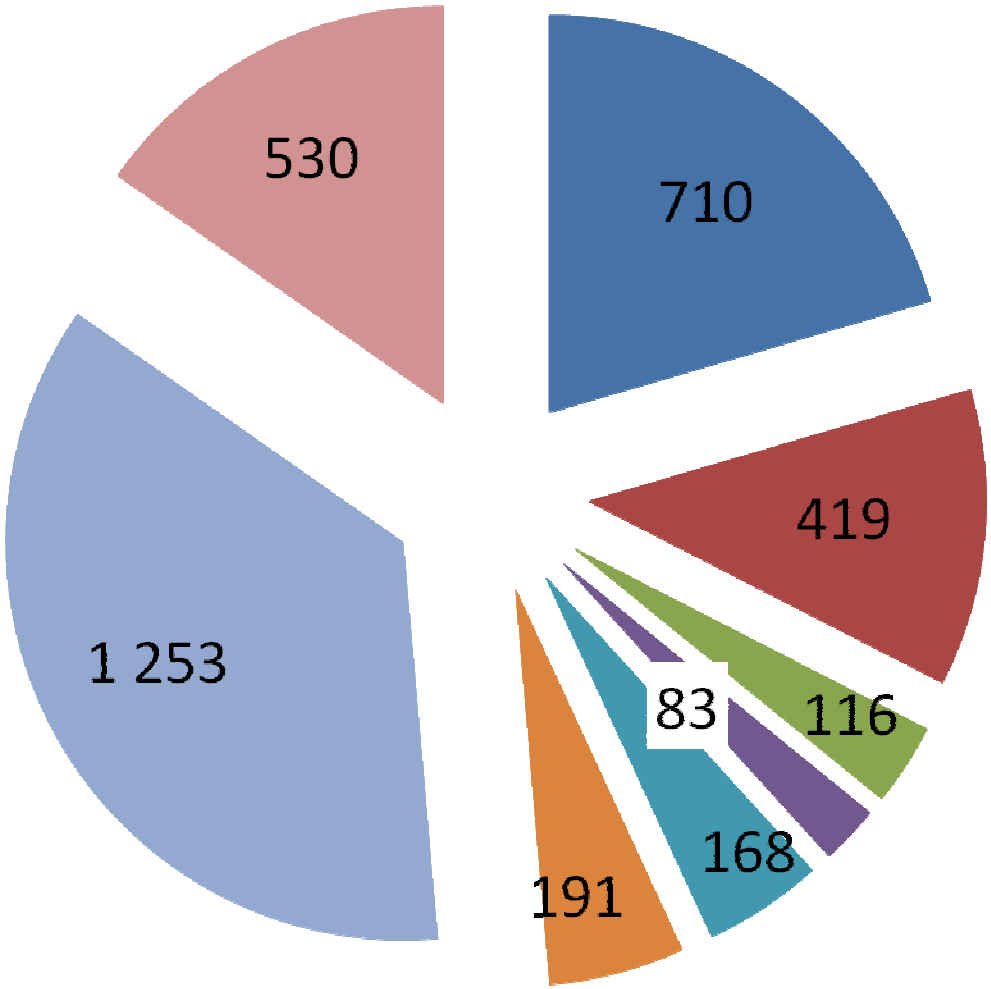
≈ 228 000

- Cattle
- Cockerel
- Goat
- Rabbit
- Pig
- Sheep
- Duck
- Equine

Collection - 2010 update

Number of donors

CRYOBANQUE NATIONALE

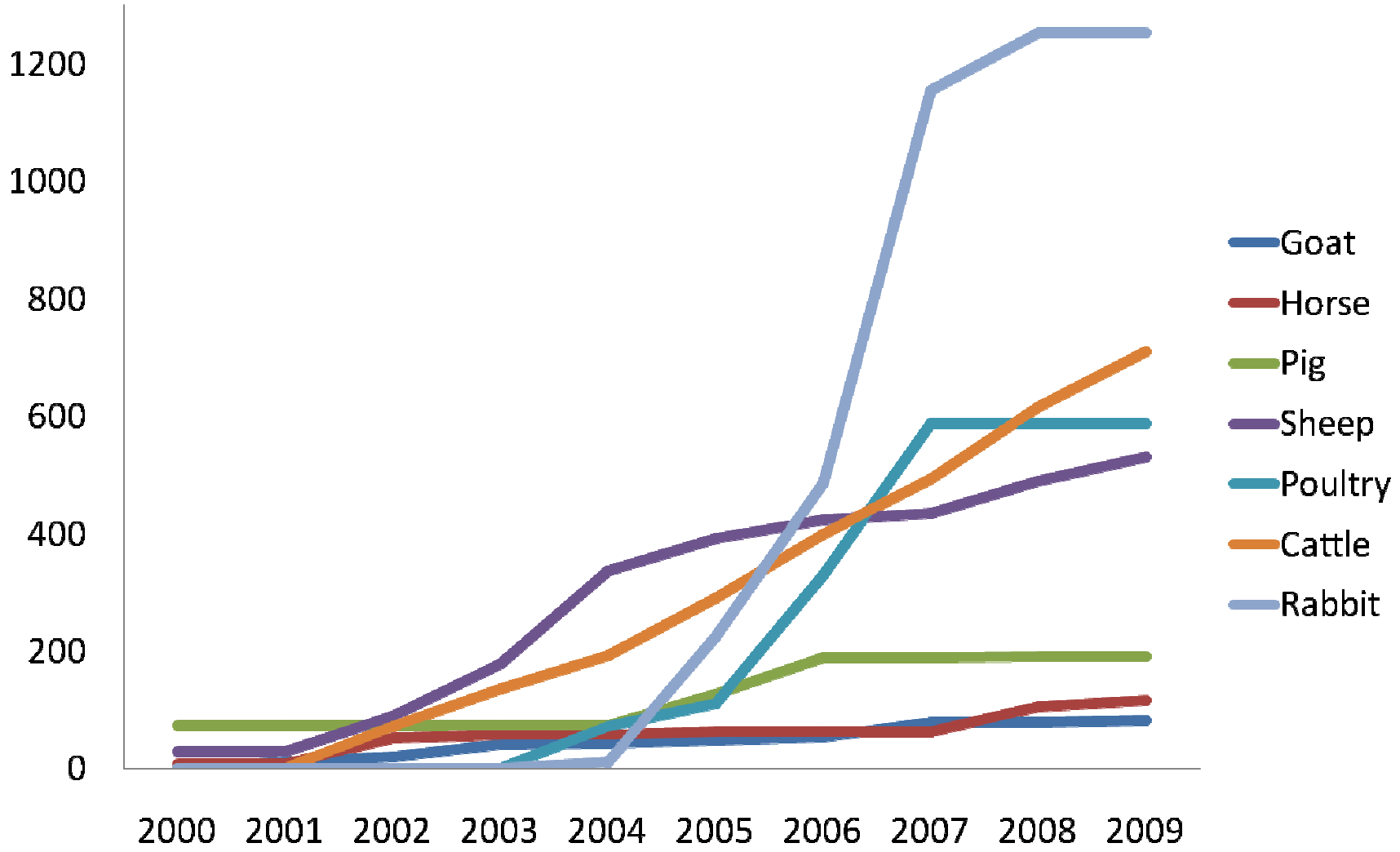


3 470 donors

- Cattle
- Cockerel
- Equine
- Goat
- Duck
- Pig
- Rabbit
- Sheep

Evolution of the number of donors per year

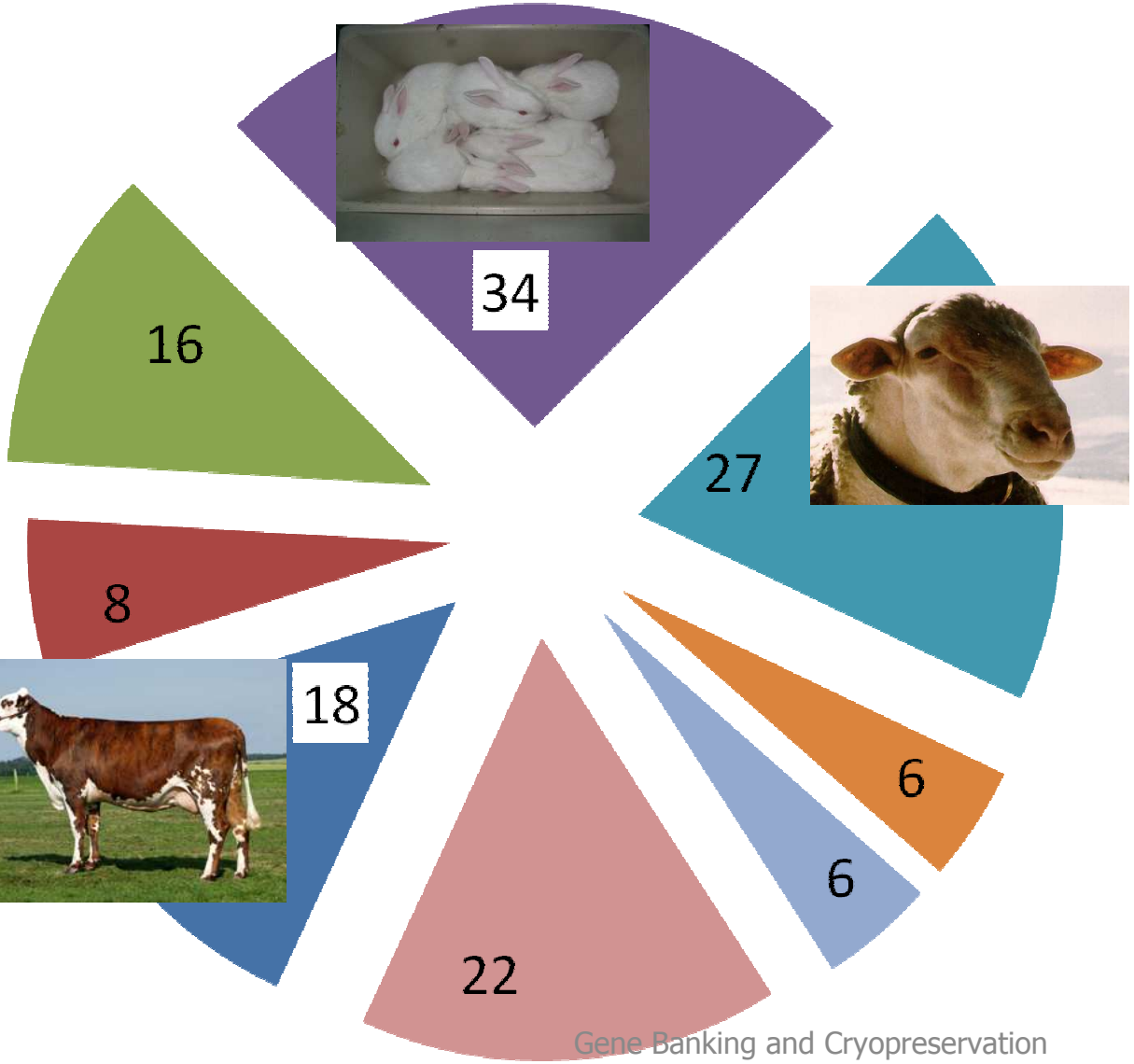
CRYOBANQUE NATIONALE



Collection - 2010 update

Number of breeds

CRYOBANQUE NATIONALE



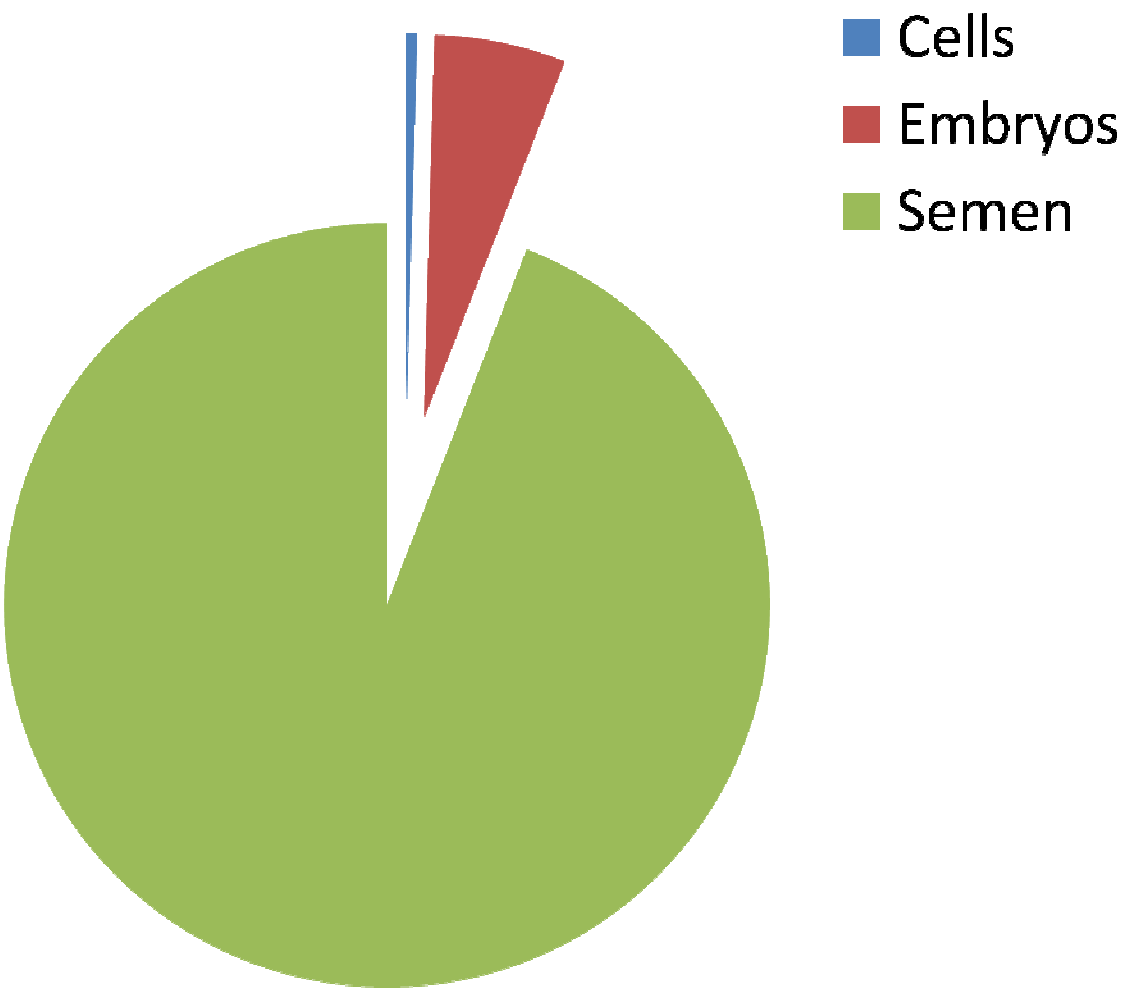
137 breeds

- Cattle
- Goat
- Horse
- Rabbit
- Sheep
- Duck
- Pig
- Cockerel

Collection - 2010 update

Type of biological material

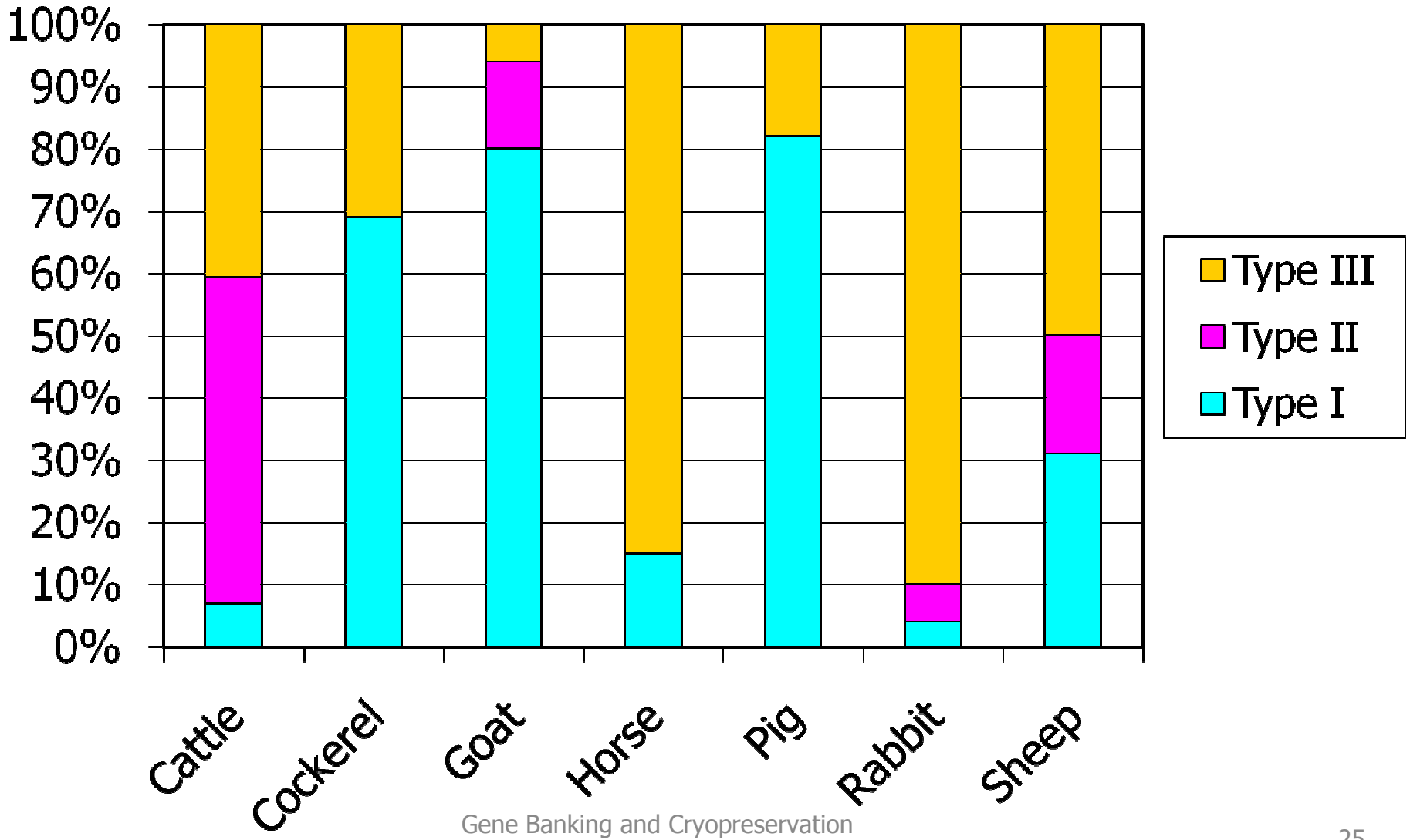
CRYOBANQUE NATIONALE



Collection - 2010 update

By genetic type

CRYOBANQUE NATIONALE



CRYOBANQUE NATIONALE

Case study: Example of the local pig breeds

How many doses should we collect ?

CRYOBANQUE NATIONALE

$$D = dN (rn - 1) / (r - 1)$$

- d =number of doses by AI
- n = number of generations of inseminated females

- N = number of females to obtain at the n generation
- f= expected number of fertile females after AI
- r=1/f
- For pig (n=5) we obtain D= 53

History of the cryopreservation programs

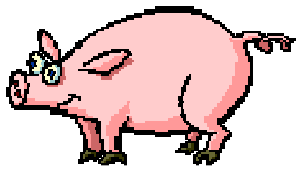
CRYOBANQUE NATIONALE

- In the eighties:

Large number of males are collected
However number of doses / male is small
Cryoconservation technique = pellets
Funding is very variable according to time / breed

- In the nineties

Specific funding (EC)
Larger number of doses collected by male
Cryoconservation technique = straws



First use of doses from the French Cryobank

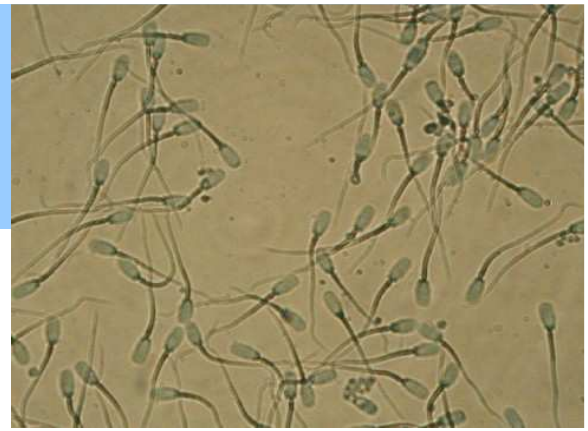
CRYOBANQUE NATIONALE

- Two local breeds (Bayeux, Blanc de l'Ouest) have tremendously reduced their genetic variability since the 80's
- Breeding associations contacted the French National cryobank to use pellets from old boars (4/breed)
- Setting up of an experiment in a research facility
- Some of the piglets obtained by AI will be collected in the future
- Quality of the semen

  "Blanc Ouest" = poor

  "Bayeux" = good

Results



CRYOBANQUE NATIONALE

- Porc Blanc de l'Ouest

Four sows inseminated => 6 to 13 live piglets/ S
2 males were collected for AI in 2009

- Bayeux

Four sows inseminated => only 2 females born !
"Multifactorial problem"
=> Sows behavior when in flock (very aggressive)
=> Sanitary problems (breeders= small holders)
=> Breed physiology very different from industrial lines

Conclusions / case study

CRYOBANQUE NATIONALE

- "Local breeds"

⇒ Farmers less likely to be used to AI protocols (or even they won't agree to do it !)

⇒ Sanitary statute might be lower than average

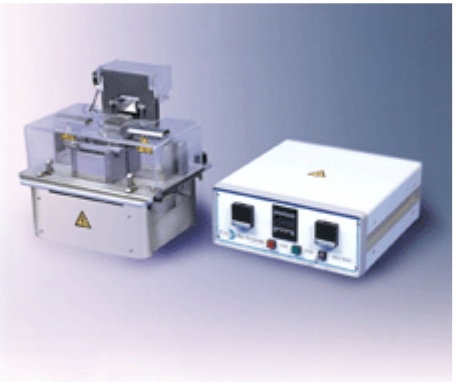
⇒ Experiment on cryopreservation, AI protocols etc. made with improved lines

- Discrepancy between theory (D= number of doses to collect / breed) and practice

=> Wiser to increase D for local breeds

CRYOBANQUE NATIONALE

Conclusion



- Cryobanks: in fashion and promoted worldwide …
- … but there are difficult to set up ! (*sampling, ownership, sanitary rules*…)
- Long term purpose =>
  - ✓ Need to be funded steadily
  - ✓ Permanent staff also needed
  - ✓ Questions raised by the collections supply

    collections not increasing ***vs*** constant raise