



# Case study: genetic management in small populations

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# Starting a conservation program

# Conservation programs: main purposes (in-situ programs)

## Demography

- Stabilization or increasing numbers of animals
- Effective breeding animals

## Genetics

- Little or no genetic gain
- Preserving genetic variability
- Limit inbreeding increase

**Several rules to follow, more or less easy to implement**

# Conservation programs: main principles

## 1) Breeds maintained with live animals, in farm

+ Complementary roles :

- live animals held by various structures (park, “eco-museum”, etc...)
- cryopreservation : Cryobanque Nationale

## 2) In-field work

- Setting up a breeders network
- Females inventory
- Recruiting and raising AI and natural services males

## 3) Genetic management: do your best !

- More or less elaborated methods and programs

## 4) Source of funding are essential

Regional, National, European

## Setting-up a conservation program: 4 steps

- **Inventory :**

- ✓ **Breeds:** looking for historical data (pictures, local papers, testimony from all breeders...)

- ✓ **Animals, breeders** (*see later*)

- **Genetic and phenotypic characterization**

- **Conservation / Genetic management**

- **Economic development**

## Setting-up an Inventory

- Inventory of the last breeders by **in-field investigation**
- When pure or interesting part bred animals are found, printing of **simple data**:
  - Name/Id of the animal
  - Sex
  - (Approximate) DOB
  - Pedigree (or name of the breeder)
  - Simple morphological description (color, horns, wattles)
- List of farmers is **spread** to all breeders with information on the males used in each farm

# About genetic variability

# Managing the genetic variability

Genes reservoir

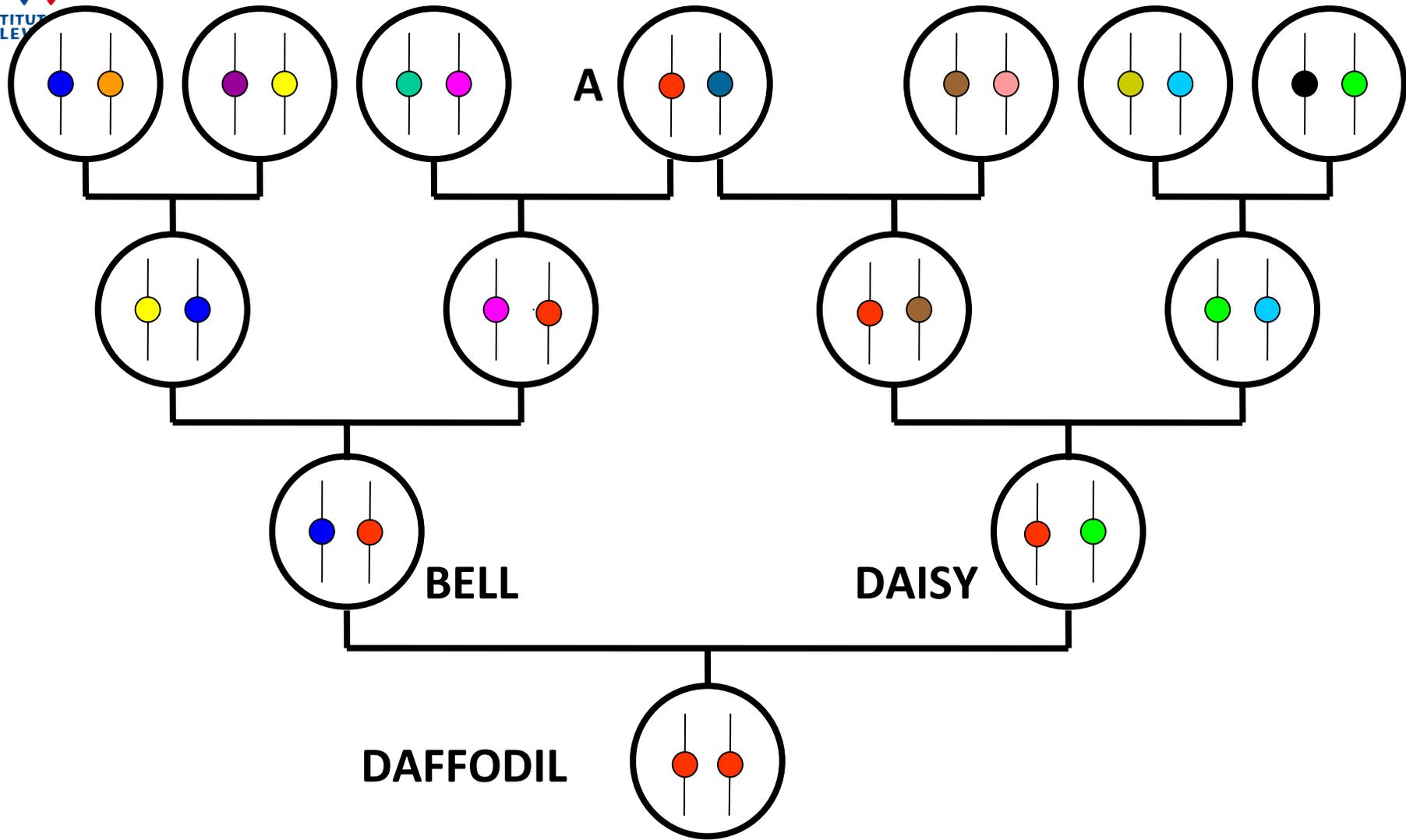


Limit the risk of diffusion of non-wanted genes  
(ex. BLAD)



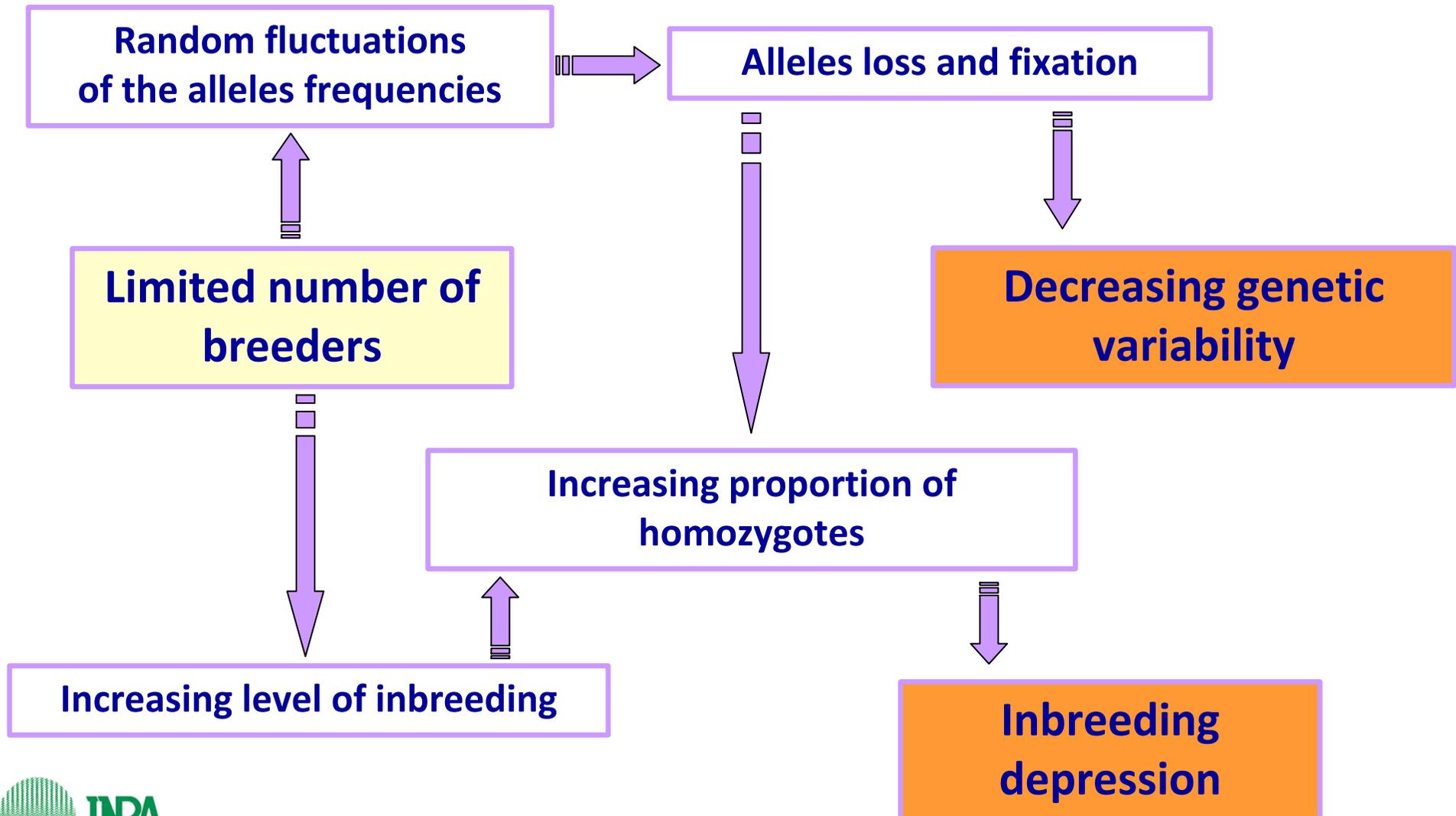
Limit inbreeding depression





Bell and Daisy are **related** / Daffodil is **inbred** /  
 A is Daffodil **main ancestor**

# Why are we focusing on inbreeding ?



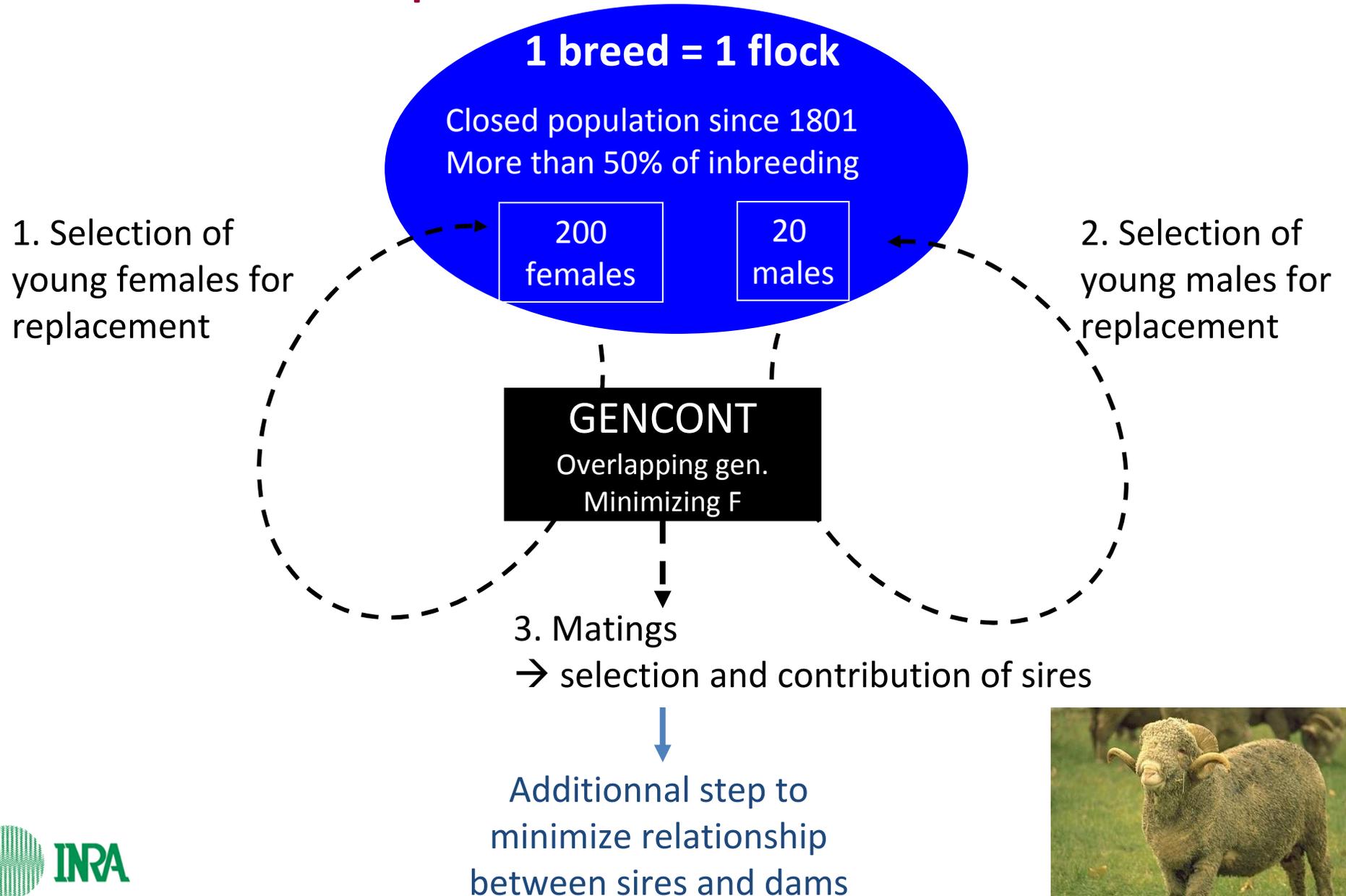
# Example of genetic management in small populations (France)

# Optimization of genetic contribution (1)

- Aim: Minimizing the rate of inbreeding  
→ ex: GENCONT
- Only in populations with:
  - Good pedigree knowledge (based on kinship coefficient)
  - “Total control” of the breeders (to comply with the recommendations)
- Very efficient method... but with requirements hard to comply with “in-field” constraints

# Optimization of genetic contribution (2)

## Example of Rambouillet Merino flock



# Groups splitting (1)

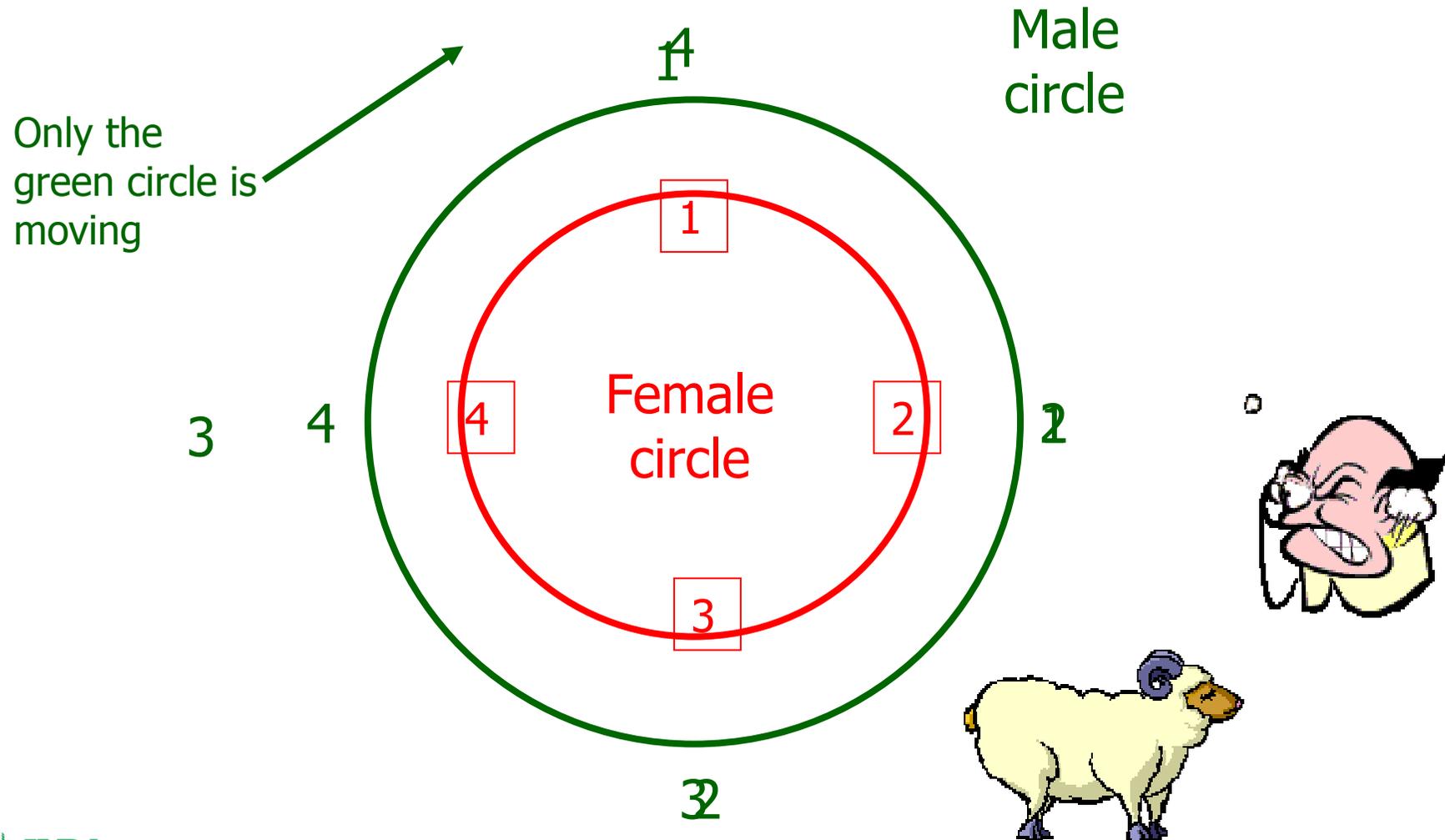
- Adapted to conservation or selection scheme
- Group = Flock OR Family → related animals
- Main rule:

Even out the **progeny size** (males mostly) of each group

→ choice of replacement breeders (males)  
**within** group



# Groups splitting (2) Rotational scheme



## Groups splitting (3)

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Very simple to set up “on paper”

Effectiveness is proven theoretically and in-field

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Downsides are worse when rules are not respected

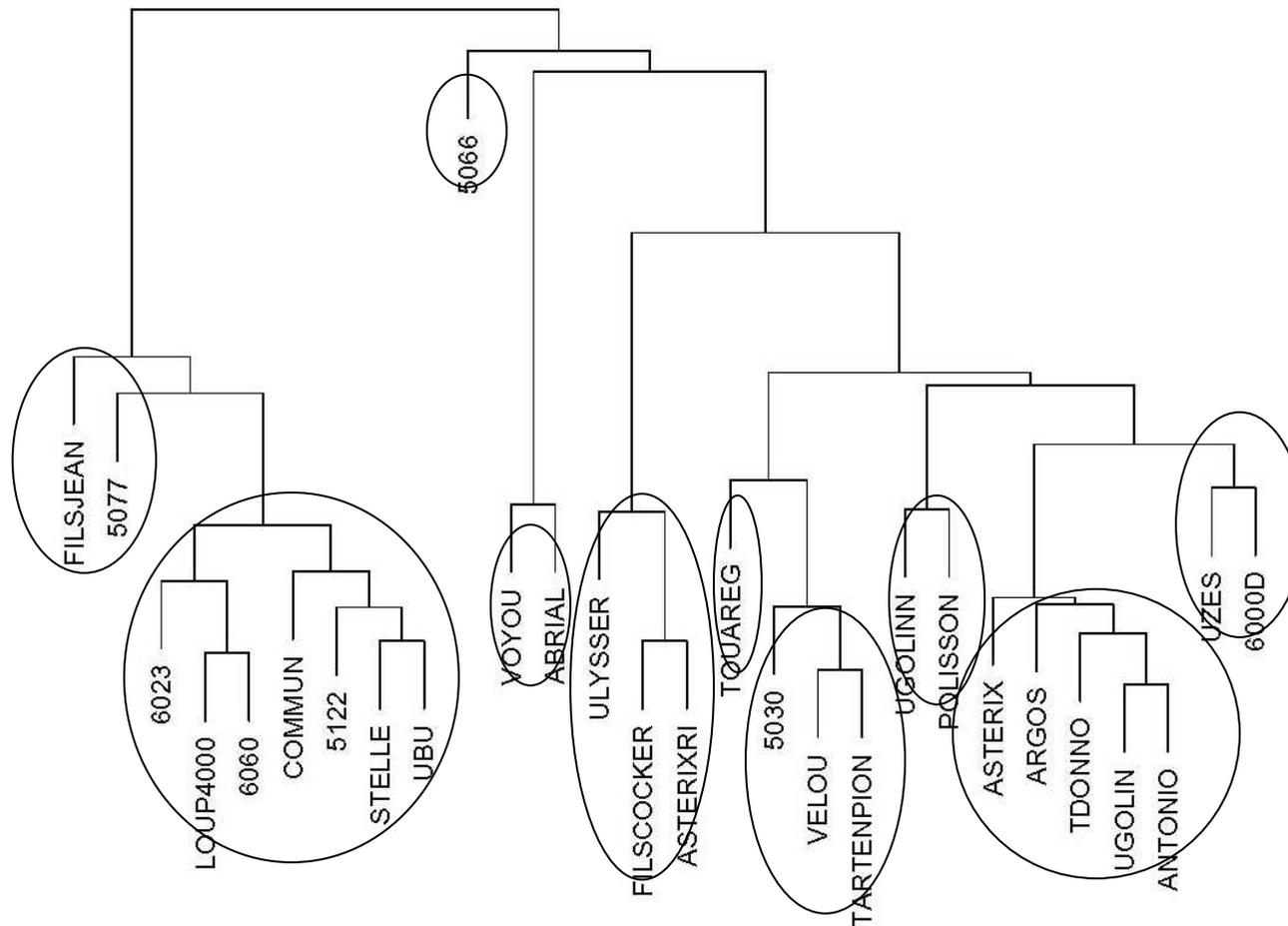
Not adapted to breeders that want to choose their replacement males

# “Program for beginners” (1)

1. Yearly **update** of each farmers data
2. **Teaching** farmers simple genetic management rules:
  - a. Changing males every two years
  - b. Avoid using a male born in its own farm
  - c. Use one male / max. 40 females
3. **Checking** the genetic variability of the population (PEDIG software)
  - Analysis of the inbreeding evolution
  - Analysis of founders effect
4. Choice of replacement males
  - a) Males are grouped according to their **kinship (between** males)
  - b) Average kinship between replacement males and reproducing females
5. Semen **cryopreservation** of males from different groups

# “Program for beginners” (2a)

## Dispatching males



# “Program for beginners” (2b)

## Dispatching males

		Buyers			
Flocks	Males	BR	BL	BN	BC
BR	1	Forbidden	Not advised	Not advised	Not advised
	2	Forbidden	Not advised	Not advised	Not advised
BN	3	Not advised	Not advised	Forbidden	Not advised
BC	4	Not advised	Not advised	Not advised	Forbidden

	<b>Forbidden</b>
	<b>Not advised</b>
	<b>Recommended</b>

## “Program for beginners” (3)

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Fairly simple to set up (use of PEDIG software)

Efficient way to manage genetic variability

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Need regular update of the pedigree data

Collective organization and understanding are needed

# SAUVAGE (1)

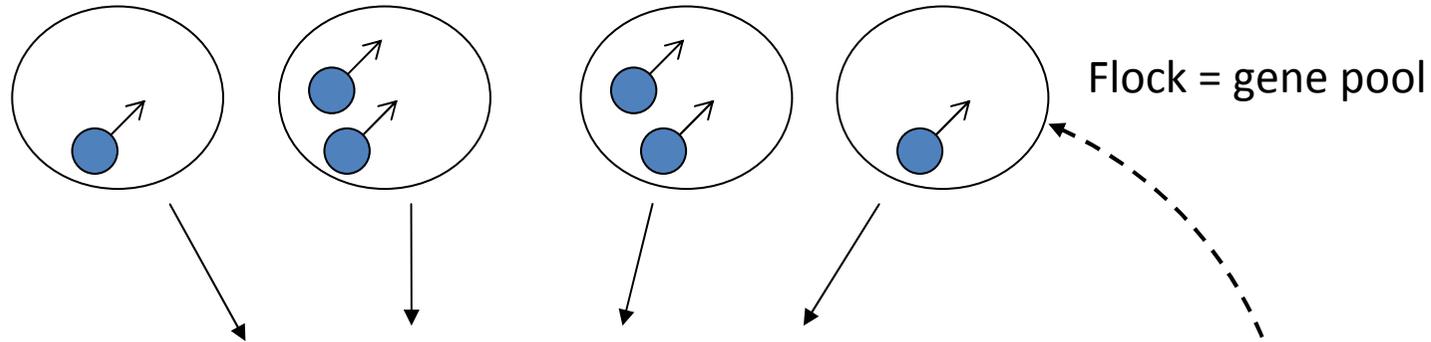
- Software based on a method from H. de Rochambeau, INRA
- Context: develop a management method:
  - For population with no/few pedigree and without selection programme
  - Easy to apply (less constraints than rotational scheme)
- Method :
  - Based on flock genetic contributions
  - Measure of similarity between a male and the females of a given flock



**Optimize the gene transfer/mixing at the population level  
(exchange of males)**

# SAUVAGE (2)

Active sires



**New generation :  
young males for replacement**

Optimal dividing up  
of males among flocks

Flock = gene pool

Table of similarity measures

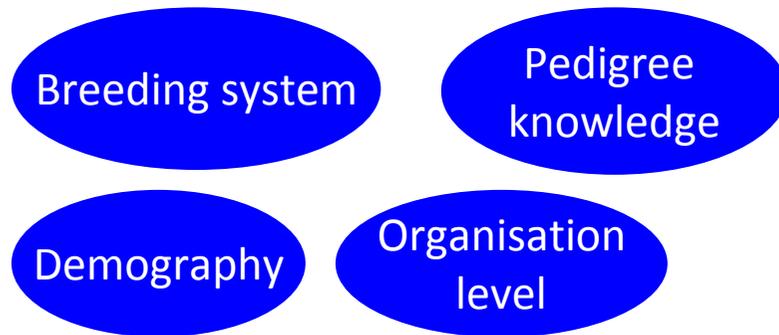
	<b>flock1</b>	<b>flock2</b>	<b>flock3</b>	<b>flock4</b>
<b>Male1</b>	0.25	0.03	0.01	0.07
<b>Male2</b>	0.18	0.08	0.07	0.22
<b>Male3</b>	0.03	0.02	0.06	0.20
<b>Male4</b>	0.09	0.05	0.12	0.04

<b>&gt;0.10</b>	<b>Forbidden</b>
<b>0.05 &gt; x &gt; 0.10</b>	<b>Not advised</b>
<b>&lt;0.05</b>	<b>Recommended</b>

# Conclusions

# How to manage a large number of breeds with different objectives

## Wide range of populations



## Wide diversity of methods

More or less: - simple to use  
- efficient  
- sophisticated

Different tools / softwares



## Find a method adapted to each situation

related to the farmers way of **thinking** !

adapted to the farmers way of **breeding** !

does not necessarily need a high level of **accuracy** in pedigree information !

# Keys for successful conservation programs

- Accumulation of information on the breed
- Spreading that information to farmers
- In depth knowledge of the farmers situation
- Trust between the breed manager and farmers
- Improvement of the program as confidence/learning increase



## Management of genetic variability

→ Population level

→ Collective