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Rotational mating for conservation of genetic diversity

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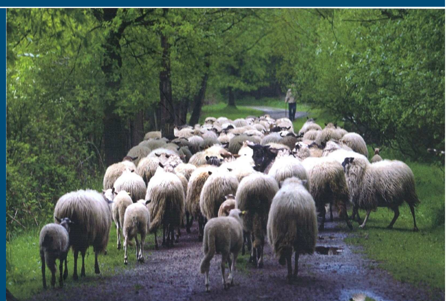
Genetic conservation

- Minimise average relatedness
- Optimal contribution
  - c'Ac
  - Best method
- Practical problems
  - No reliable pedigree
  - No (regular) DNA typing possible
  - Population consists of herds/flocks/subpopulations
    - Herd owners (want to) decide on selection and mating
  - Complex
    - Hard to explain
    - Technical skill needed
  - Strong central organization needed



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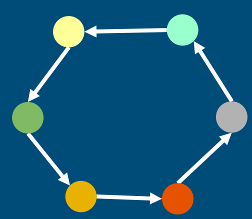
Objective

- Is rotational mating a reasonable alternative for Optimal Contribution?
  - How effective?
  - What type of rotational mating?
  - Suitable for what kind of population?

Rotational Mating

Maximum avoidance of inbreeding (MAI)



Breeding Circle

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Effect rotational mating Kempisch Heideschaap

- Heath sheep
  - Eight flocks – 1800 Individuals
  - Grazing on poor soils
- Computer simulations
  - Using population structure, litter size, age structure etc. of real 2004 population
  - Selection for scrapie resistant genotypes
  - Scenarios evaluated
    - No exchange between flocks
    - MAI
    - Breeding Circle
  - Each scenario, average of 25 simulations

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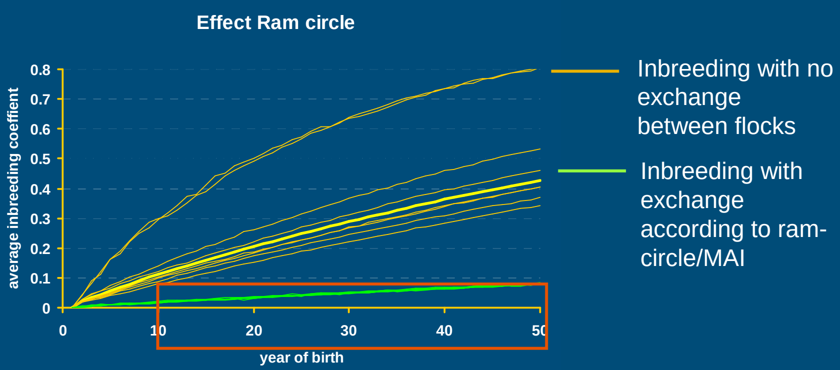
Effect rotational mating Kempisch Heideschaap



- All flocks have lower inbreeding
- Differences in inbreeding disappear
- MAI and Breeding Circle very similar

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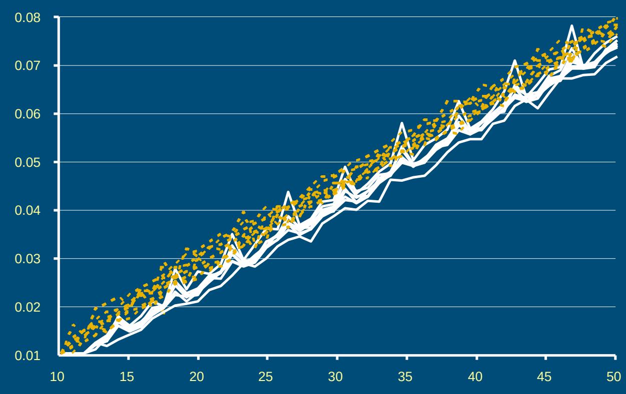
MAI vs Breeding Circle



ΔF more variable under MAI

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Practical advantages breeding circle

- Each year same structure
  - Once started nothing needs to be changed
- Circle can be adapted to population structure
  - Minimal geographic distances
  - Avoidance of “incompatible” herds
- New herds can be incorporated easily

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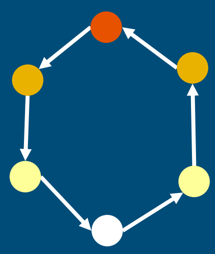
Effect of number of herds

- Several large herds
  - Low inbreeding within herds
  - High relatedness between herds
  - Diversity conserved within herds
- Many small herds
  - High inbreeding within herds
  - Low relatedness between herds
  - Diversity conserved between herds



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Questions remaining

- What is the most efficient structure?
  - When to group/split herds?
- Are inbreeding rates for MAI and breeding circle always similar?
  - MAI more efficient with many herds???
- Effect when combined with selection?
  - Has been done (Scrapie-control)
  - How much efficiency is lost?
  - Sire reference schemes are somewhat similar

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Method to use depends on existing situation

- Commercial nucleus
  - Reliable pedigree, full control over mating and # offspring, single herd
  - Optimal Contribution
- Laboratory population (e.g. Drosophila)
  - Many (unrelated) subpopulations, no pedigree
  - MAI
- Heath sheep
  - Few large flocks, no pedigree, different owners
  - Breeding circle
- Other situations
  - Herds with different owners
  - Also zoos, wild populations, …
  - Often breeding circle

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Conclusion

- Breeding circles are
  - Efficient in reducing inbreeding rates
  - Practical
  - The alternative for Optimal contribution when
    - Pedigree is unavailiable / unreliable / incomplete
    - Control over selection of parents and mating limited

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