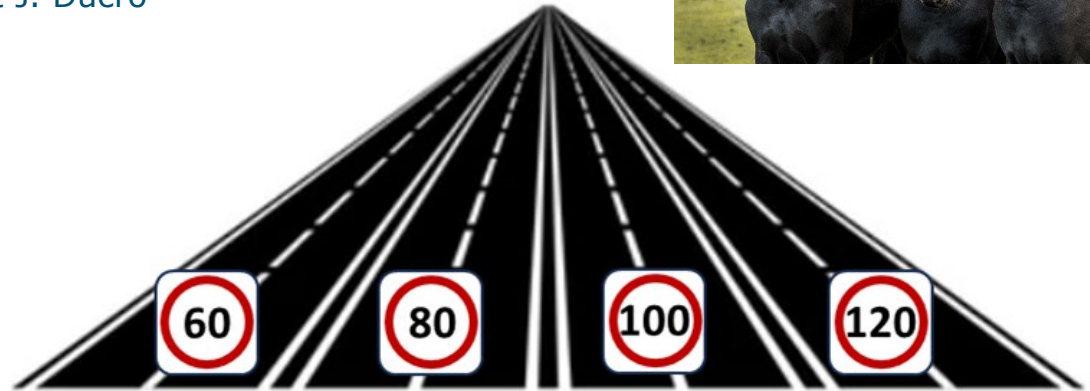


Stratified mating quota: a novel approach to effectively reduce inbreeding rate

A case study applied to the Friesian Horse population

75th EAAP Annual Meeting

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Martijn F. L. Derks, Nynke Bakker & Bart J. Ducro



Inbreeding and its management

- Many livestock populations have high inbreeding rates
 - Selection
 - Skewed sire contributions
- Inbreeding rate per generation (ΔF) should be $<1\%$ and preferably $<0.5\%$ (FAO)
- Theoretical best solution is optimal contribution selection
 - often practically not feasible $\rightarrow$ other alternatives needed

Aim

Evaluate the **effectiveness** of **breeding strategies**, including a novel approach of **stratified mating quota**, using **stochastic simulations**

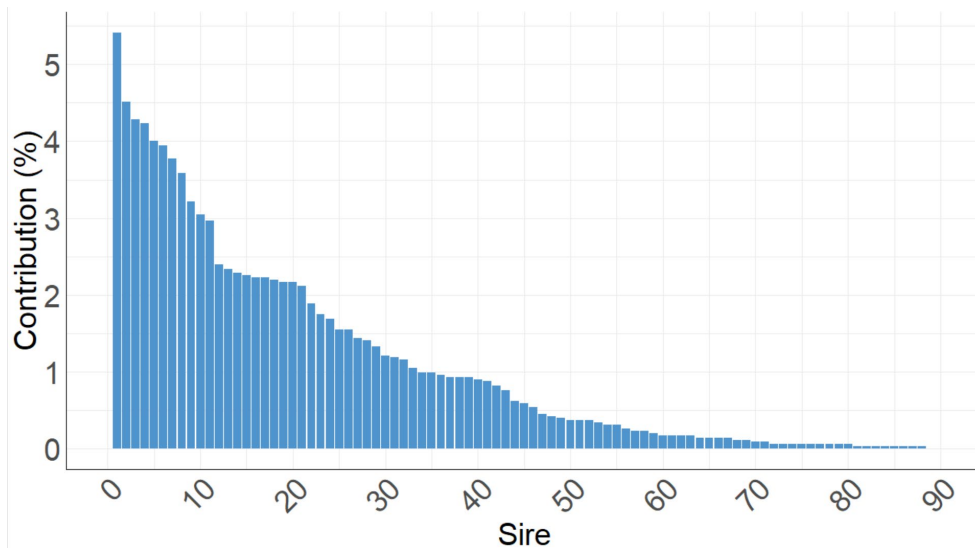
Friesian horse population as case study

■ Population statistics:

- 3,500 foals born per year from approved sires
- ~100 approved breeding sires
- closed population status
- bottlenecks in the past
- skewed sire contribution

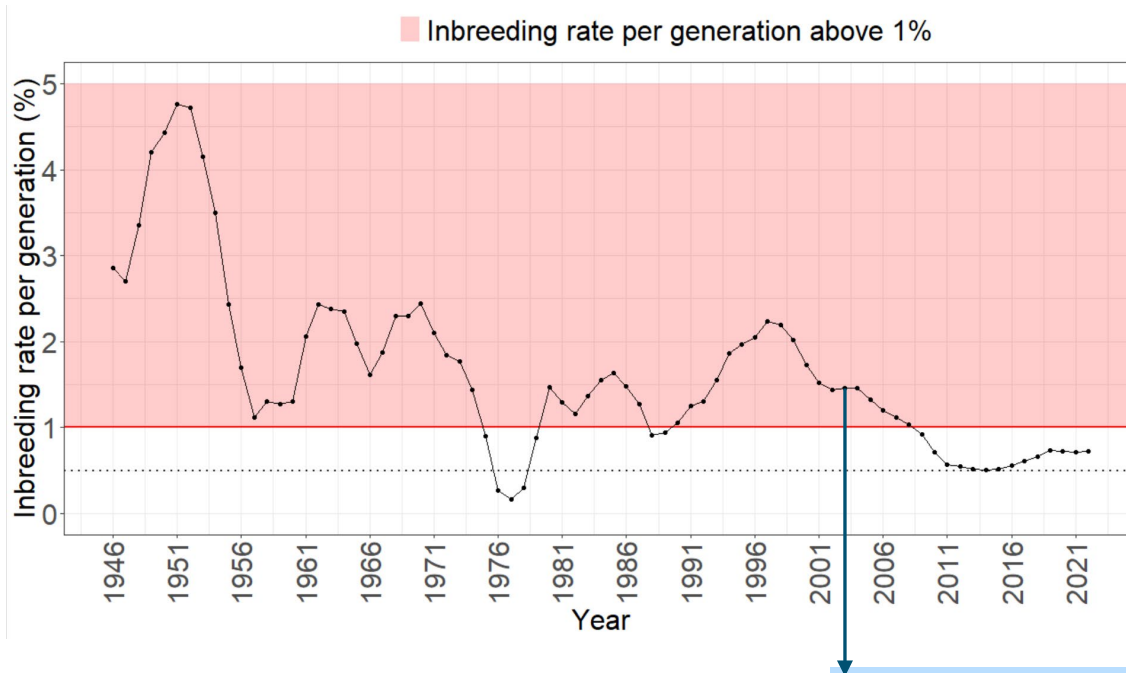
➤ High inbreeding rates

The 10 most popular sires responsible for 35% of offspring in 2022



Current situation of the Friesian horse population

- Current inbreeding rate (ΔF) = 0.72% per generation



2003: Breeding limits of 180 (5.1%) breedings/sire/year and individual kinship values published

Materials & Methods

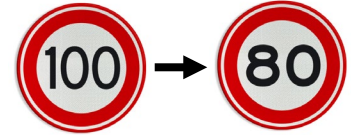
- Stochastic simulations using MoBPS (v 1.11.10) over 75 years with 25 repeats
- Include pedigree of Friesian horses ($N = 163,035$) since 1880
- Include population characteristics
 - 90 breeding sires and 3500 breeding mares per year
 - Contribution of sires based on 2022
 - Constant population size
- Mimicked selection
 - Single quantitative trait with selection accuracy = 0.5

Possible strategies simulated

1 Increase the number of parents



2. Stricter mating quota



3. Mean kinship selection – only use sires with lower than average f



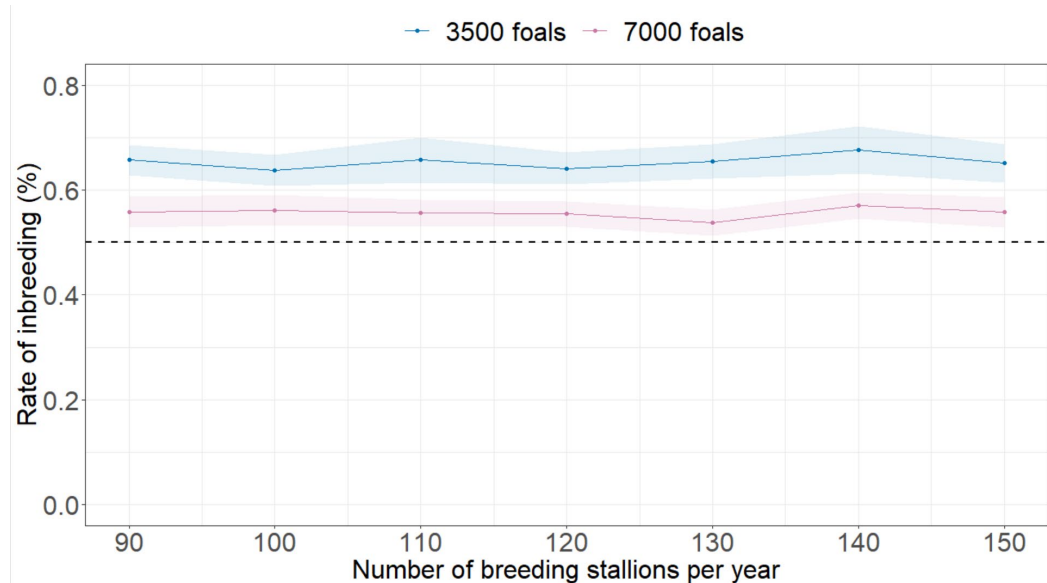
4. Stratified mating quota – mating quota depends on kinship of the stallion



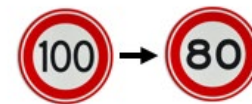
1. Increase the number of parents



Strategy	ΔF (current sim. $\Delta F = 0.66\%$)
1. More sires (N = 90 $\rightarrow$ 150)	No effect
1. More mares (N = 3,500 $\rightarrow$ 7,000)	0.56%



2. Stricter mating quota



- Current breeding limit is 180 matings/sire/year
- Maximum of 100 (2.9%) or 80 (2.3%) offspring per sire per year

Strategy	ΔF (current sim. $\Delta F = 0.66\%$)
1. More sires ($N = 90 \rightarrow 150$)	No effect
1. More mares ($N = 3,500 \rightarrow 7,000$)	0.56%
2. Mating quota (max. 100 offspring/sire/year)	0.57%
2. Mating quota (max. 80 offspring/sire/year)	0.55%

3. Mean kinship selection



- Only use sires with lower than average mean kinship (50% sires is selection candidate)
- Mean kinship level = average kinship of a sire to all foals born in the last three years

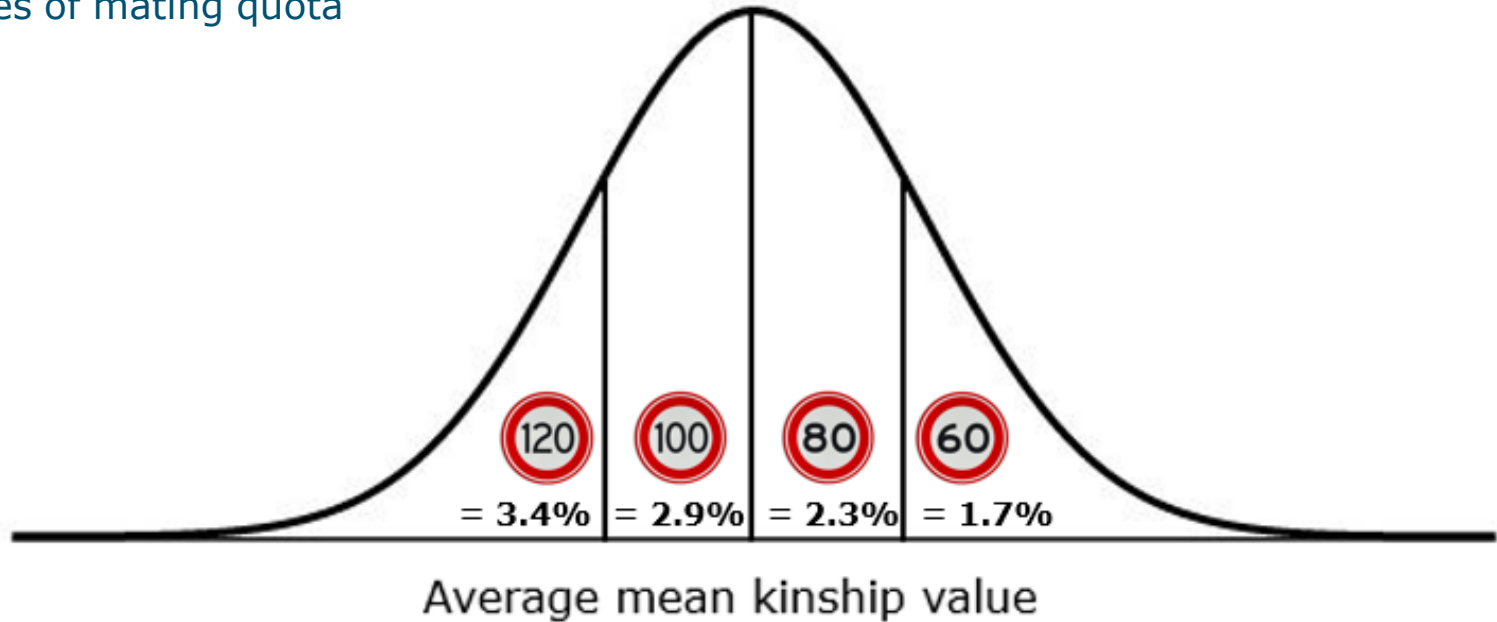
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1. More mares (N = 3,500 → 7,000)	0.56%
2. Mating quota (max. 100 offspring/sire/year)	0.57%
2. Mating quota (max. 80 offspring/sire/year)	0.55%
3. Mean kinship selection	0.33%

Very effective → but hardly accepted

4. Stratified mating quota



- Sire with higher individual mean kinship has a stricter mating quota
- 4 classes of mating quota



4. Stratified mating quota



- Sire with higher individual mean kinship has a stricter mating quota
- 4 classes of mating quota

Strategy	ΔF (current sim. $\Delta F = 0.66\%$)
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2. Mating quota (max. 80 offspring/sire/year)	0.55%
3. Mean kinship selection	0.33%
4. Stratified mating quota (120,100,80 or 60 offspring/sire/year)	0.43%

Stratified mating quota more effective than general quota

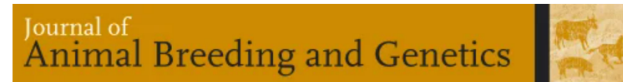


- Stratified mating quota more effective than a general mating quota

- Stratified mating quota (mating quota = 120, 100, 80, 60) $\Delta F = 0.43\%$

- General mating quota (mating quota = 80) $\Delta F = 0.55\%$

- Use of close relatives will be restricted



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Evaluation of breeding strategies to reduce the inbreeding rate in the Friesian horse population: Looking back and moving forward

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Stratified mating quota: optimal N of classes?



Stratified mating quota		ΔF
1. Current: four classes	(60,80,100,120)	0.43%

Stratified mating quota: optimal N of classes?



Stratified mating quota		ΔF
1. Current: four classes	(60,80,100,120)	0.43%
2. Two classes	(60,120)	0.46%

Stratified mating quota: optimal N of classes?



Stratified mating quota		ΔF
1. Current: four classes	(60,80,100,120)	0.43%
2. Two classes	(60,120)	0.46%
3. Two classes	(80,100)	0.56%

Stratified mating quota: optimal N of classes?



Stratified mating quota		ΔF
1. Current: four classes	(60,80,100,120)	0.43%
2. Two classes	(60,120)	0.46%
3. Two classes	(80,100)	0.56%
4. Continuous classes	(60-120)	0.47%

Take home message

- Stratified mating quota as novel approach:
 - more effective than a general mating quota
 - practically acceptable for the Friesian horse population
 - four classes seem optimal
- Applicable to other species with high ΔF and popular sire effects

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