Inbreeding management in Nordic Holstein

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VIKINGGENETICS
innovative breeding

AARHUS
UNIVERSITY

VikingGenetics facts

- Cooperative owned by 17,000 farmers
- Three home countries
  - Denmark – Headquarter and bull station
  - Sweden
  - Finland – Embryo production station
- Three daughter companies
  - Australia
  - Germany
  - United Kingdom
- Export to 50+ countries

VikingHolstein facts

- Common Nordic breeding program
- Total number of Holstein cows **570,671**
  - Denmark 357,989
  - Sweden 118,926
  - Finland 93,756
- Average milk kg **11,335** (11,440 ECM kg)
  - Fat 458 kg and 4.04%
  - Protein 392 kg and 3.46%

Two types of inbreeding

Mating between individuals who share common ancestors

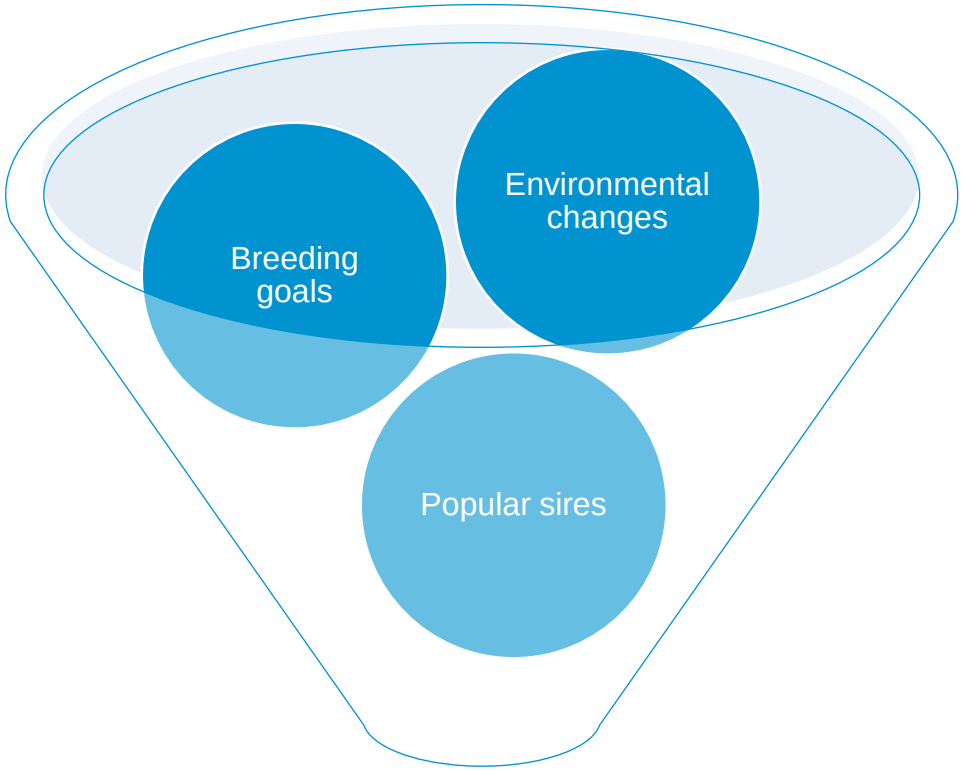
Long term

- Ancient inbreeding
- Slow increase
- Neutral or even positive effect

Short term

- Inbreeding in few generations
- Fast increase
- Negative effect on traits

What causes inbreeding?

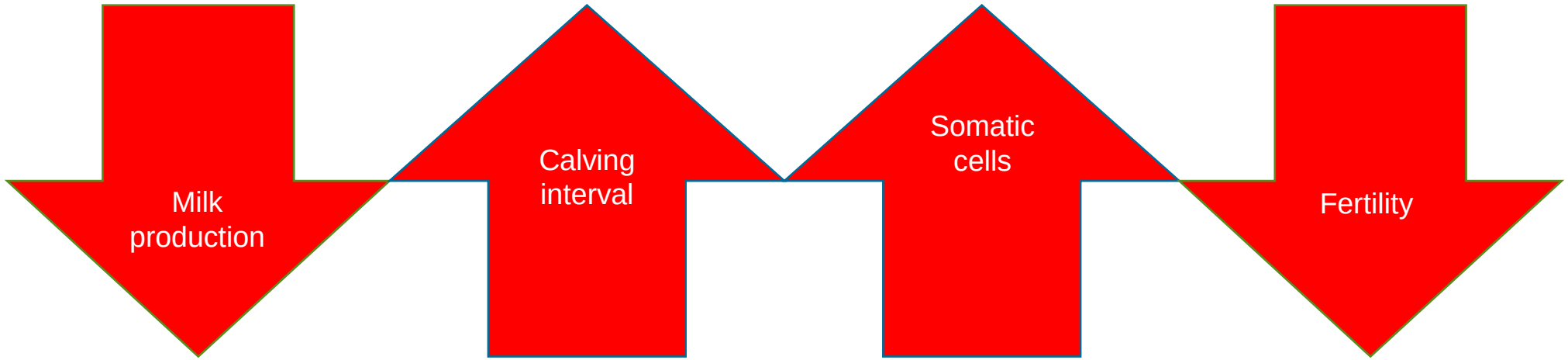


Genetic bottleneck

Inbreeding depression

What inbreeding depression means in dairy cattle?

Short-term inbreeding in dairy cattle causes



Doekes, H. P., Veerkamp, R. F., Bijma, P., de Jong, G., Hiemstra, S. J., & Windig, J. J. (2019). Inbreeding depression due to recent and ancient inbreeding in Dutch Holstein–Friesian dairy cattle. *Genetics Selection Evolution*, *51*(1), 54.

Actions by VG to control inbreeding

Maximize genetic gain while restricting increase of inbreeding

Short term

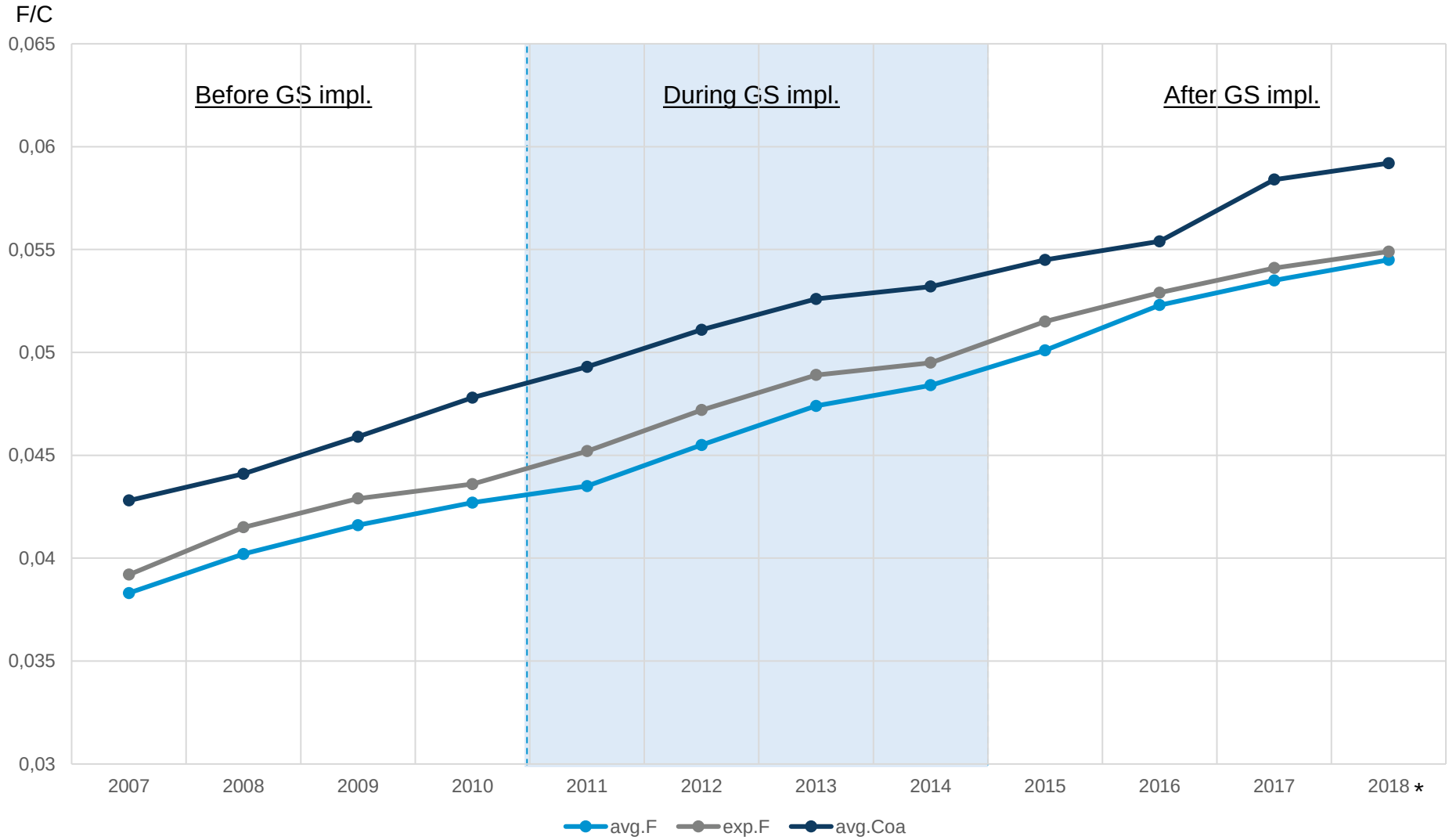
- Farm level matings
- Limits on inbreeding
- Breeding softwares for selection

Long term

- Breeding company
- Optimal contribution selection (OCS)
- Multitrait breeding values

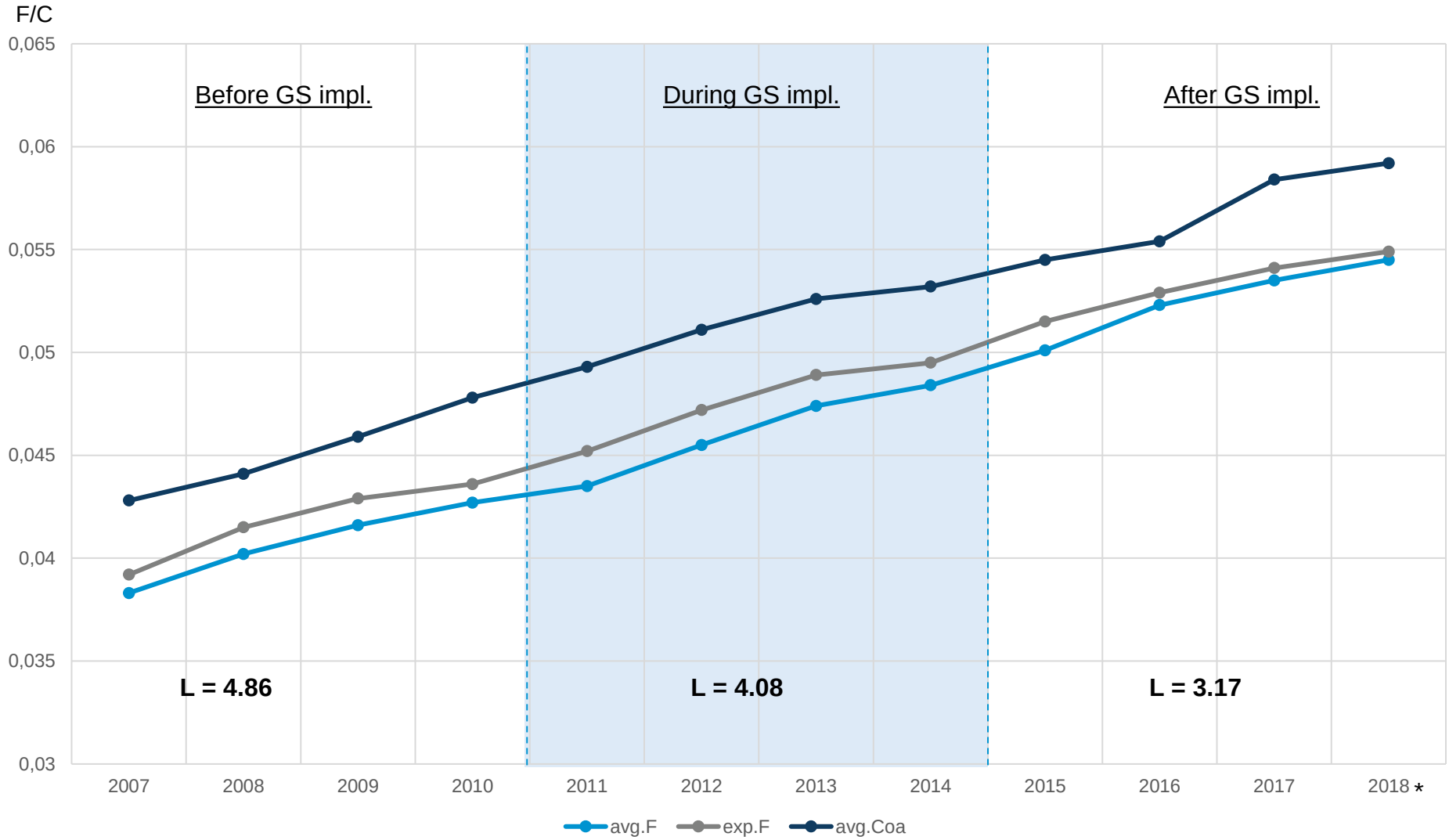
How well have we managed inbreding in the Nordic?

Inbreeding and coancestry trend



* 2018 is a partial year. Data was collected until November 2018.

Inbreeding and coancestry trend



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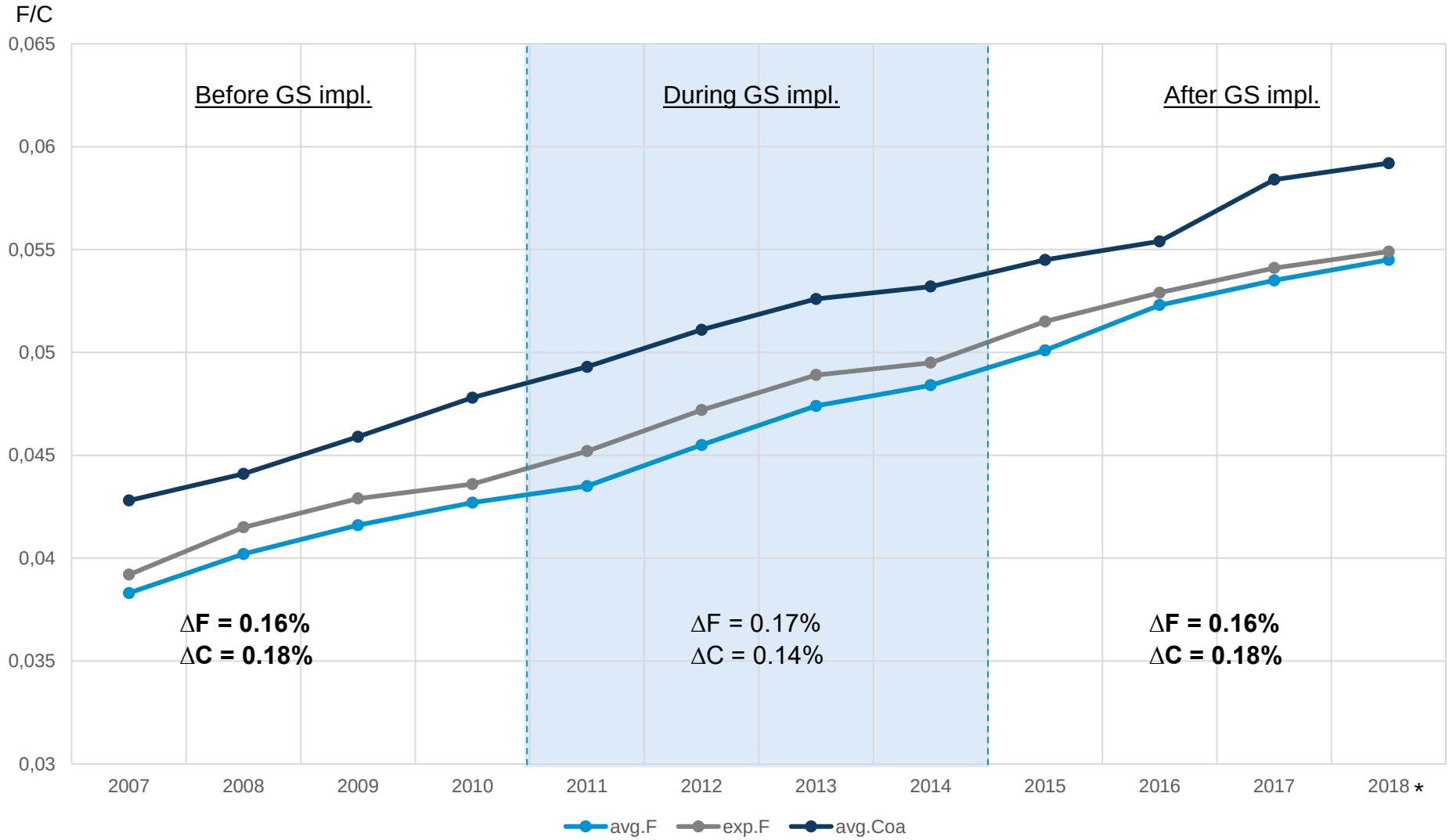

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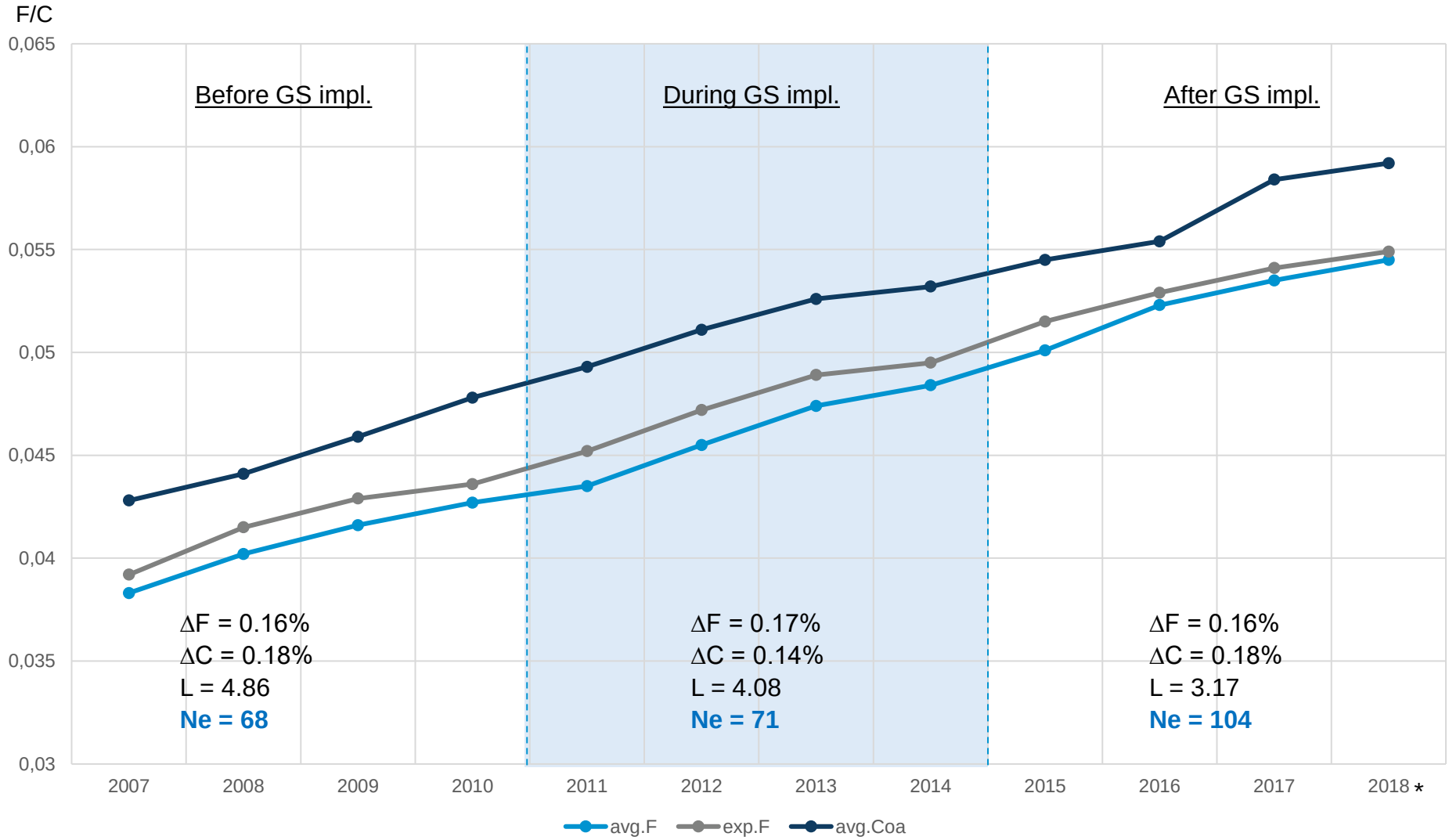

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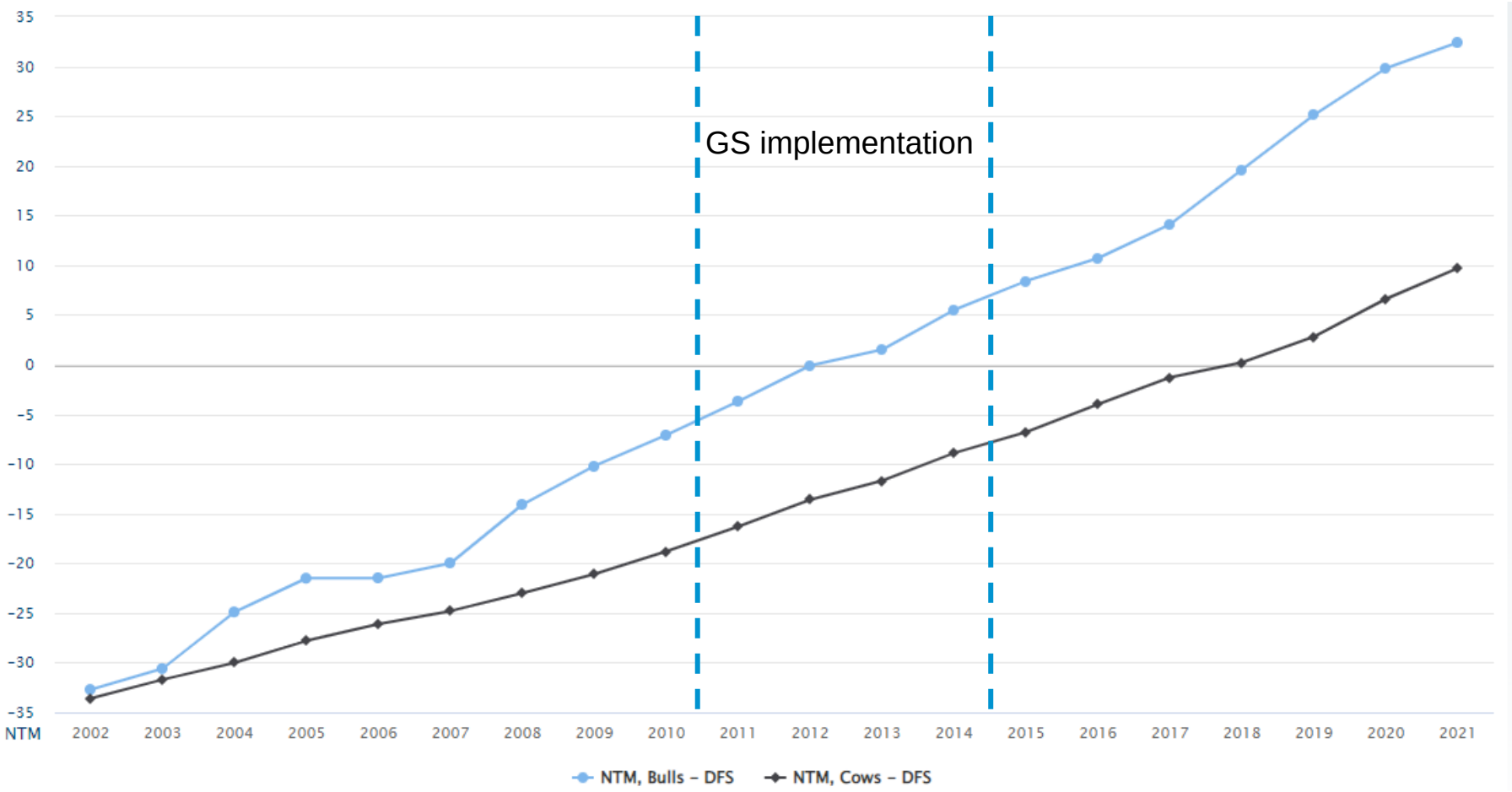
Genomic trend Nordic Holstein



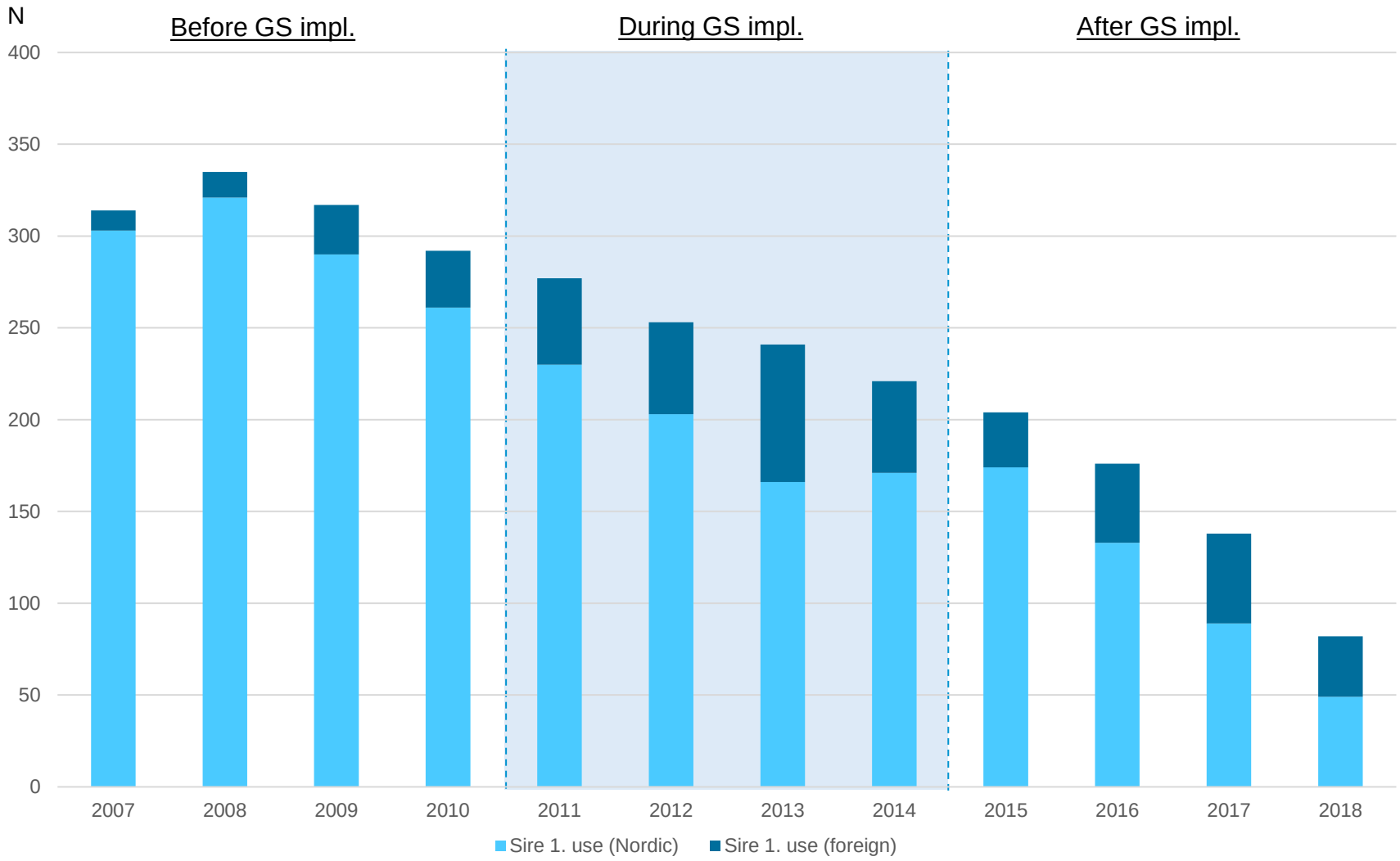
Source: Nordic Cattle Genetic Evaluation https://nordic.mloy.fi/NAVTrends# taken 7.7.2022

Simulations before genomic selection

- Before genomic selection, more bulls were selected to the breeding program
- Simulation studies before GS
  - Increasein number of females in the reference population
  - Number of bulls required for sustainable breeding scheme

→ Number of bulls in the breeding program decreased dramatically

Number of bulls used



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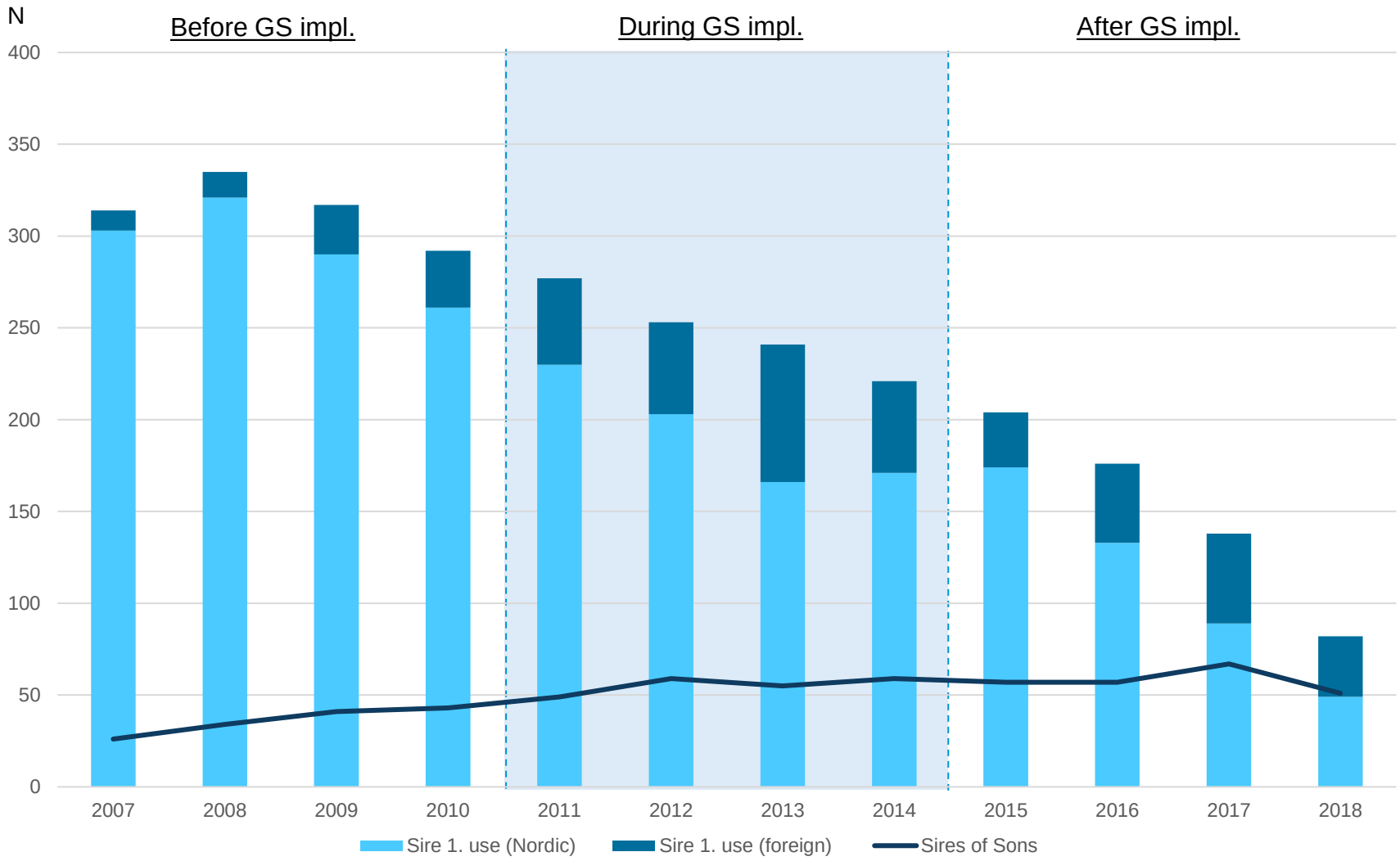

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VikingHolstein breeding program now

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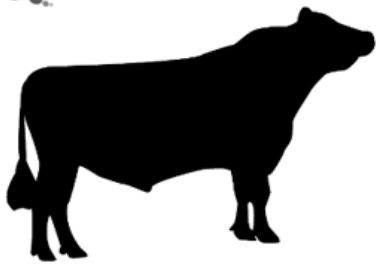
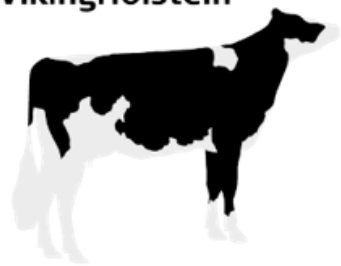


2,800 bulls
Genomically tested

70 bulls
bought

60 bulls
in production

VikingHolstein



350
Heifers contracted for flushing

65
Heifers purchased

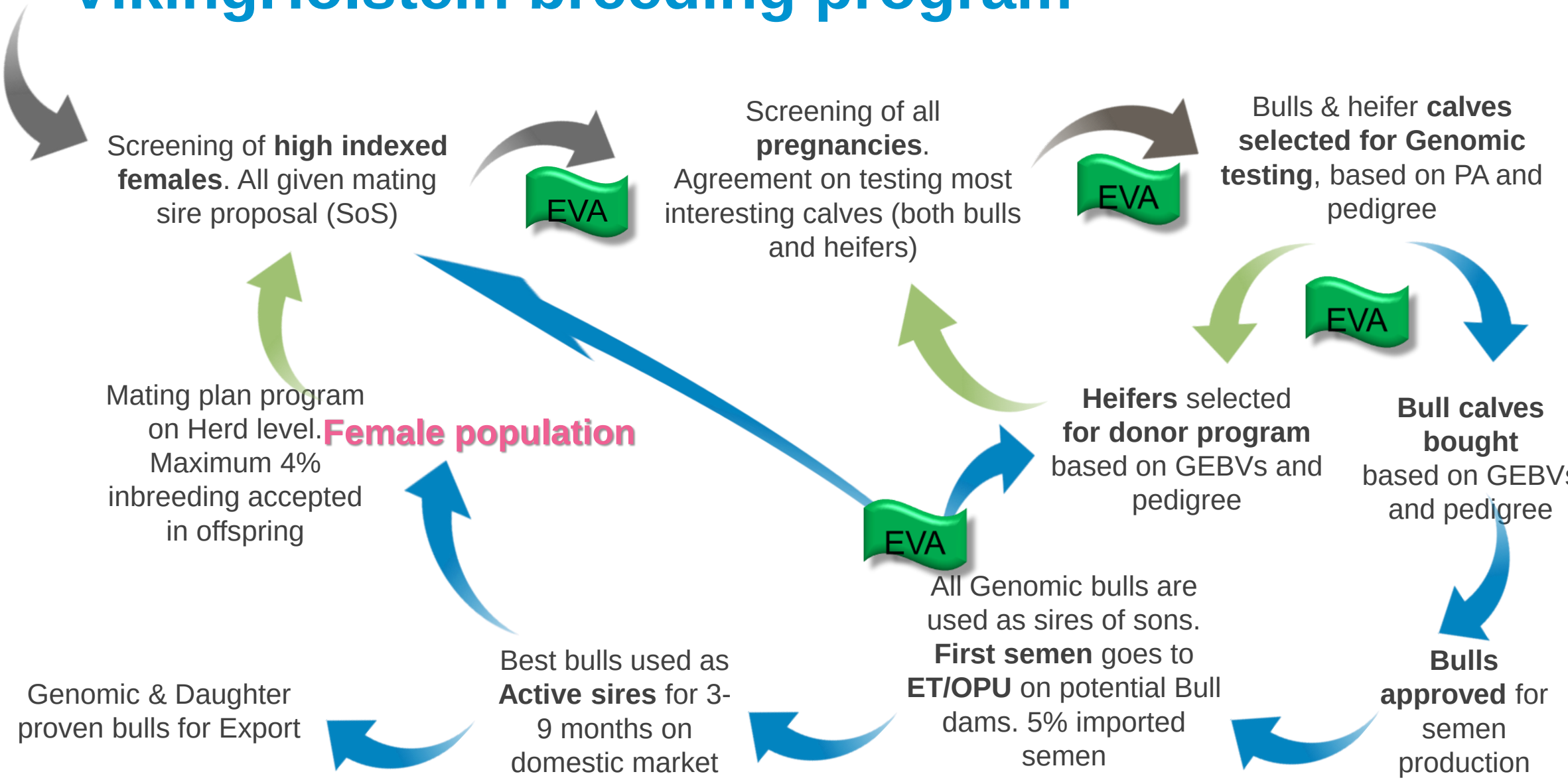
4,200
Embryos per year

Summary from the study

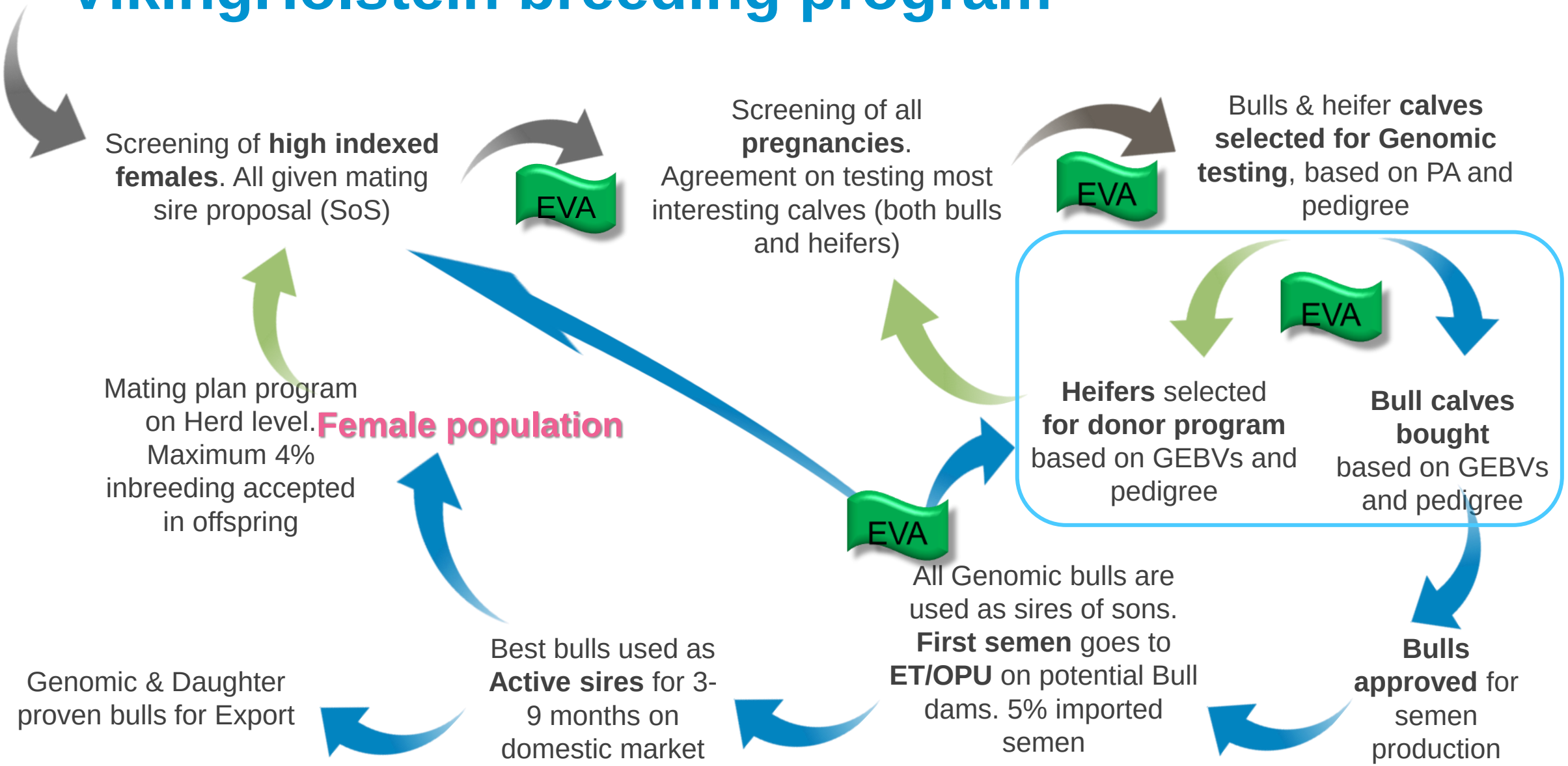
- Inbreeding and coancestry trend has been the same before and after genomic selection was implemented
- Generation interval has decreased
- Effective population size has increased
- Number of sires have decreased but number of sires of sons have increased
- Based on statistics in NAV, genetic gain has incrased after the genomic selection

How we manage inbreeding now?

VikingHolstein breeding program



VikingHolstein breeding program



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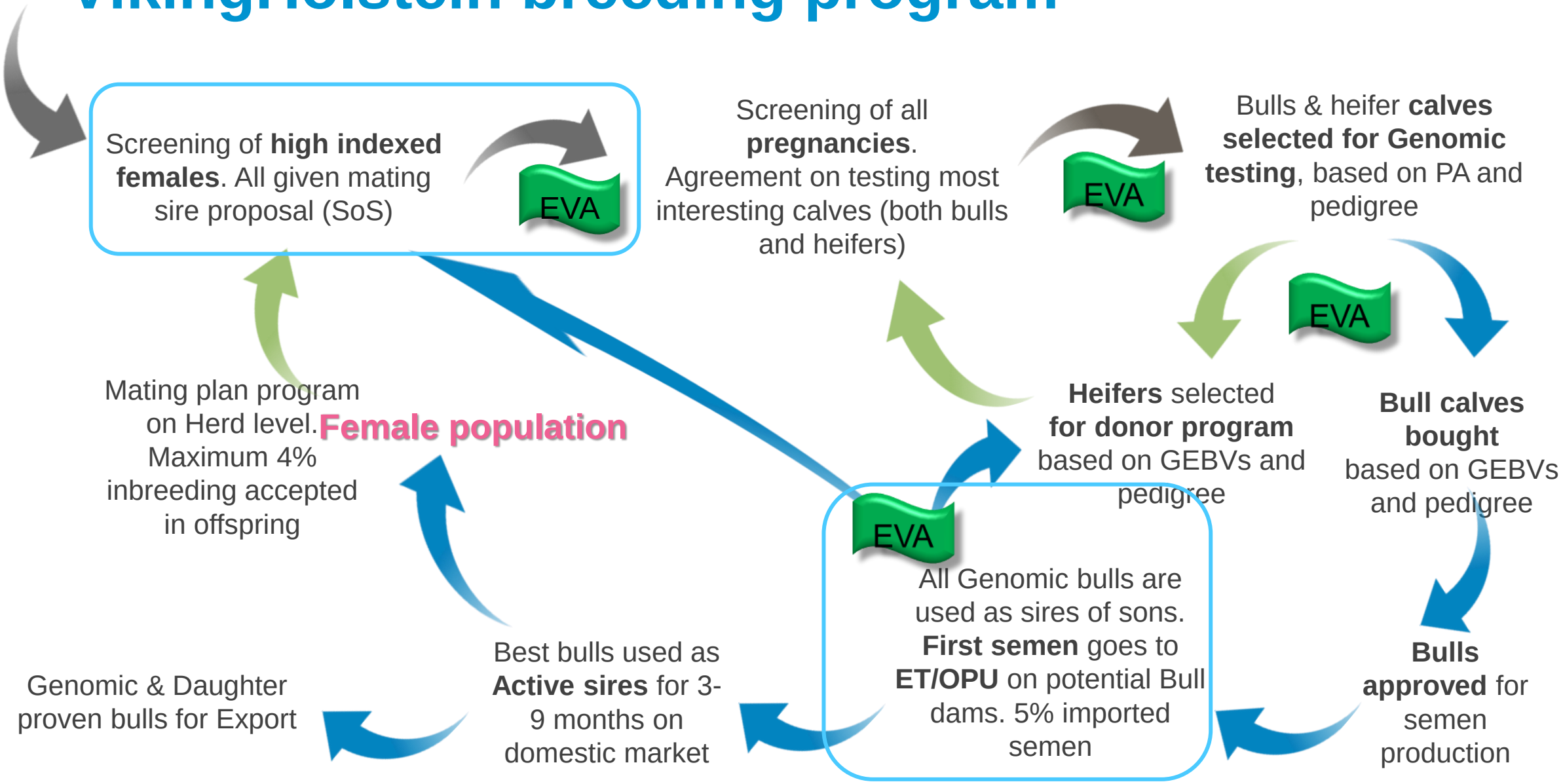
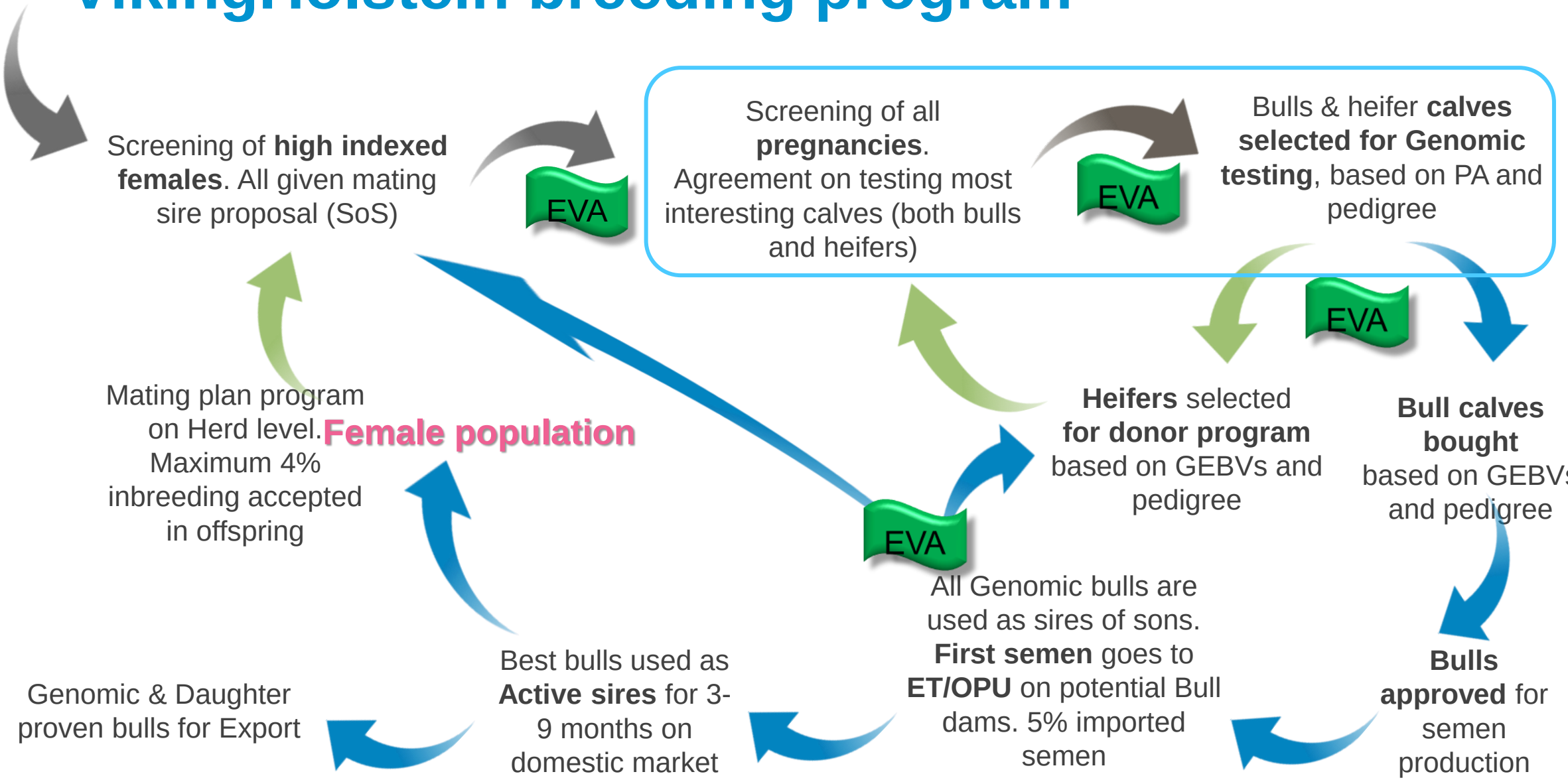


VikingHolstein breeding program



Future plans

- New PhD project:

  Balancing genetic gain and diversity in dairy cattle breeding schemes in the genomics era

  - Cooperation project between VikingGenetics and Aarhus University
  - Aim is to
    - Find optimal way to estimate inbreeding and relationships
    - control inbreeding in Nordic dairy cattle populations with genomic OCS

- New changes in the breeding program

  - Movement towards nucleus breeding
    - No bulls born in the commercial farms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