Evolution of genetic parameters of production traits and conception rate in the Dutch Holstein population

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Evolution of genetic variances

- Evolution of genetic variances: 2 processes under artificial selection
    - Reduction due to drift
        - Independent of selection
        - Only due to demographic factors
    - Reduction due to selection
        - Bulmer effect
        - (pre)selection
- Impact on genetic gain

Aim

To evaluate the evolution of
genetic variances, covariances and correlations
for milk production traits and conception rate
in the Dutch Holstein population
since 1990

Data

- Phenotypes
  - Period: 1990-2020
  - First-parity cows
  - 305-DIM milk, fat & protein yields (855,185 records)
  - Conception rate (0/1) at first insemination (676,641 records)
- Pedigree
  - Extracted up to 1970

Bivariate models

- 305-DIM yields
  - Fixed: Herd x year of calving, Age at calving, Year x season of calving
  - Random: Animal, Residual
  - Pre-corrected for heterogenous residual variances (by herd x year of calving)
- Conception rate
  - Fixed: Herd x year of calving, Year x month, Day of the week, Age of bull, Sexed semen
  - Random: Service sire, Animal, Residual

Estimation of genetic parameters – approach

- Gibbs sampling approach
    - Following Macedo *et al.* (2021) & extended to bivariate models
    - gibbsf90+
    - 150,000 iterations
    - 900 samples of EBVs (stored each 150 iterations)

- 30 groups of cows with records born between 1990 and 2019
- 28 groups of sires born between 1990 and 2017

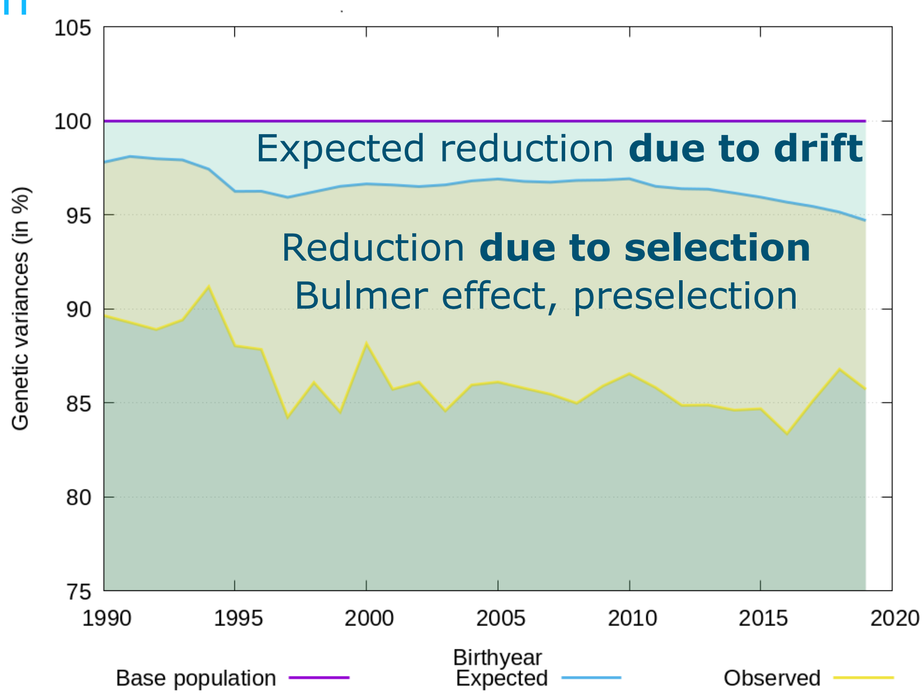
Macedo *et al.* JDS Communications. 2021, 2:31-34

Estimation of genetic parameters – approach

Genetic variance in the base population ($\hat{\sigma}_a^2$)

For each group (sex x birthyear)

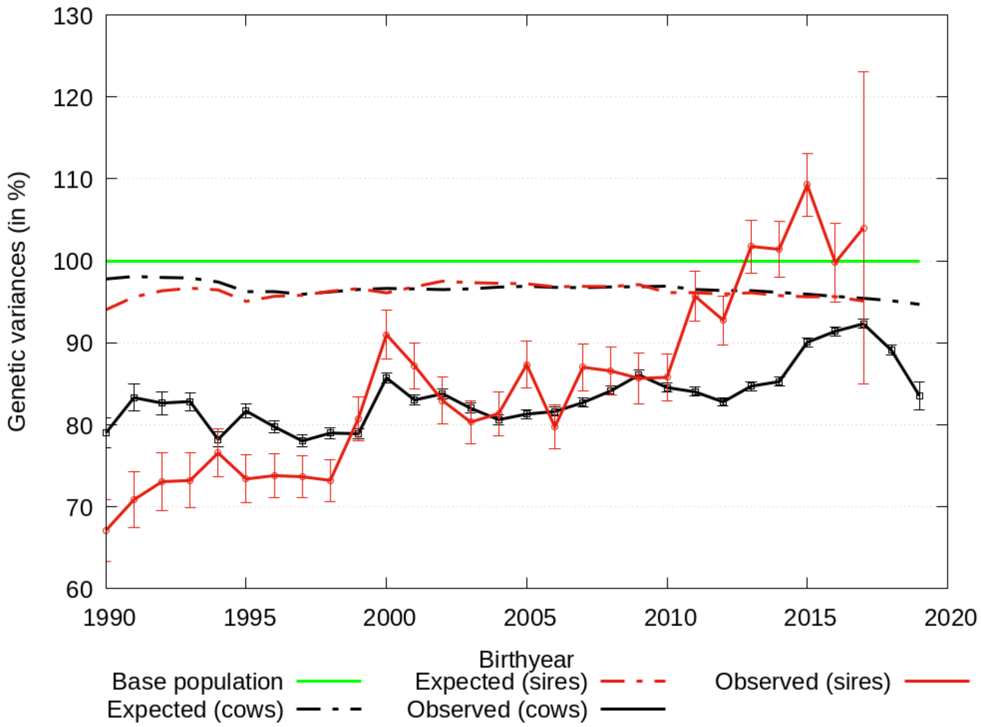
- Expected genetic variance
  - $\hat{\mathrm{E}}\left(\sigma_{a(b,s)}^2\right) = \hat{\sigma}_a^2\left(1 + \bar{F}_{(b,s)} - \bar{\mathbf{A}}_{(b,s)}\right)$
- Observed genetic variance
  - $\hat{\sigma}_{a(b,s)}^2 =$ Average variance of within-group BVs



Expected reduction **due to drift**

Reduction **due to selection**
Bulmer effect, preselection

305-DIM Milk yield – Genetic variances



Observed genetic variances

- Compared with base population

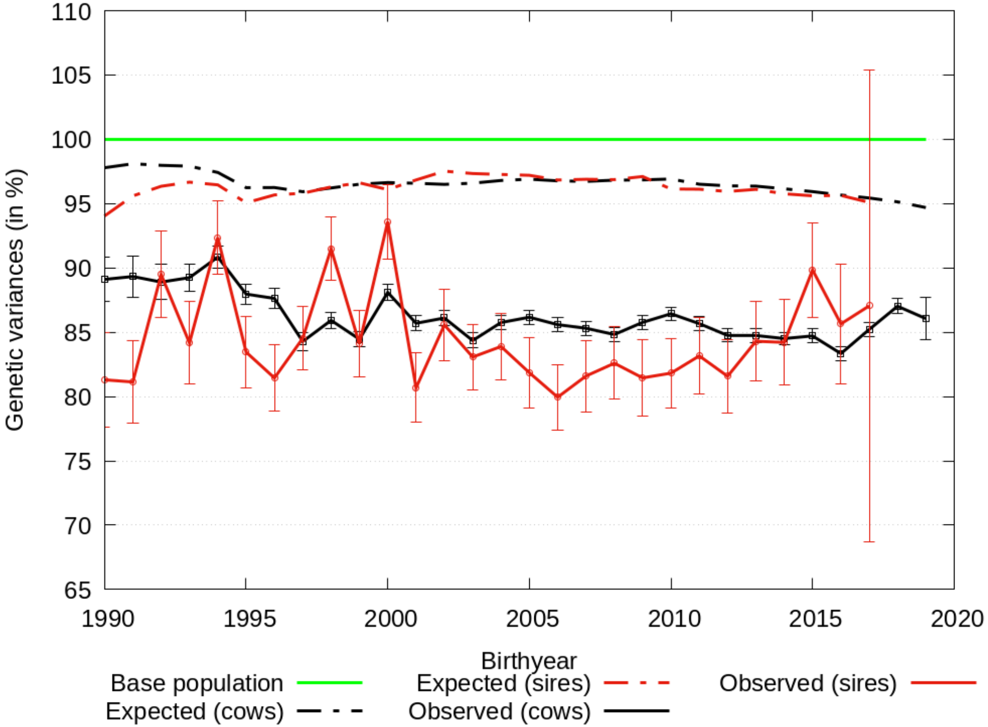
Cows

- 1990: 21% lower
- From 1990: average increase of 0.3% per year

Sires

- 1990: 33% lower
- From 1990: average increase of 1.2% per year
- From 2013: larger than base population

Conception rate – Genetic variances



Observed genetic variances

- Compared with base population

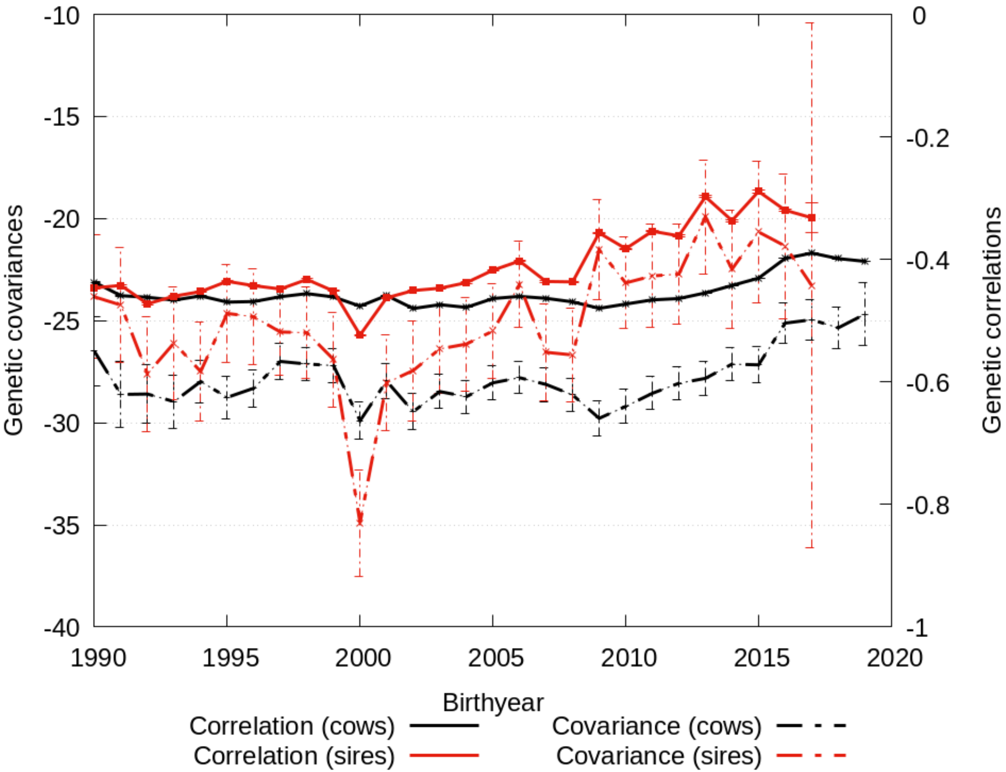
Cows

- 1990: 11% lower
- From 1990: average decrease of 0.1% per year

Sires

- 1990: 19% lower
- From 1990: average decrease of 0.1% per year

MY & CR - Genetic covariances & correlations



- Until 2008-2010
  - Rather stable
- From 2008-2010
  - Increasingly less unfavourable
  - Sires: More pronounced

Conclusions

- Observed genetic variances
    - Lower than base population (except for MY and sires>2012)
    - Evolution
        - Conception rate: limited decrease
        - Milk yield: increase (especially for sire groups)
        - Potentially due to changes in breeding goals
- Observed genetic correlations: increasingly less unfavourable!

- Similar results for 305-DIM fat and protein yields

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