Evaluation of conception rate in Nordic dairy cattle

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Nordic fertility evaluation model update

- Three breeds: Holstein, Nordic Red Dairy Cattle, Jersey
- Highlights:
  - From sire model to animal model
  - Breed-specific variance components for all traits
  - Conception rate (CR) as a new trait
  - Correction for sexed semen for CR, non-return rate (NRR), number of inseminations (AIS) and interval from first to last service (IFL)
    - NRR and CR: semen type of service
    - AIS and IFL pre-corrected:
      - Average effect of sexed semen 11% for all breeds and parities
      - 11% of average cycle: heifers 3.8 days, cows 4.6 days

Pre-correction:

AIS = original AIS – nsex * 0.11
IFL = original IFL – nsex * coefficient
nsex = number of services with sexed semen / parity

Conception rate

- Harmonization of fertility evaluations among EuroGenomics countries → Development of an evaluation for CR in Nordic countries

- Each service of a female defined as an observation
  - Maximum of 10 services / parity

- Observations for CR (0, 1, p) are defined by a complex decision process based on several information sources: services, pregnancy checks, calvings, information on selling alive, and cullings

Model

- Multi-trait multi-lactation repeatability animal model:

y = herd x first calving year (heifers: birth year)
+ insemination year x month x country
+ age of heifers at first service x country
+ service number x country
+ year class x semen type x country
+ total heterosis
+ permanent environment
+ additive animal
+ residual

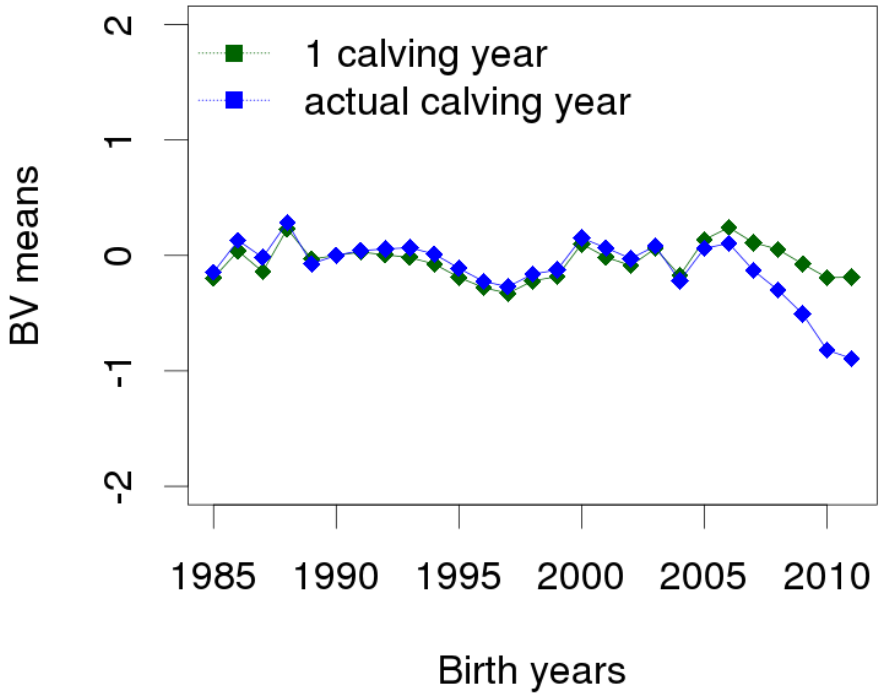
y is a repeated observation either within trait CR0, CR1, CR2, or CR3

Fixed effect
Random effect

- Pre-adjustment for heterogeneous variance

Modeling herd-year: actual calving vs. first calving year

Interval from calving to first service, cows

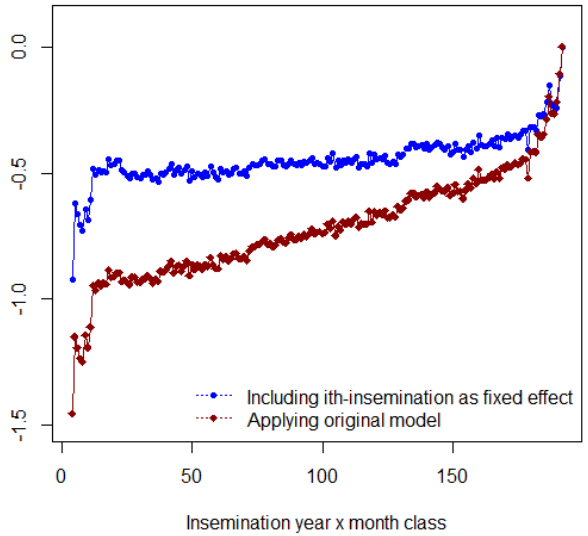


Modeling service number

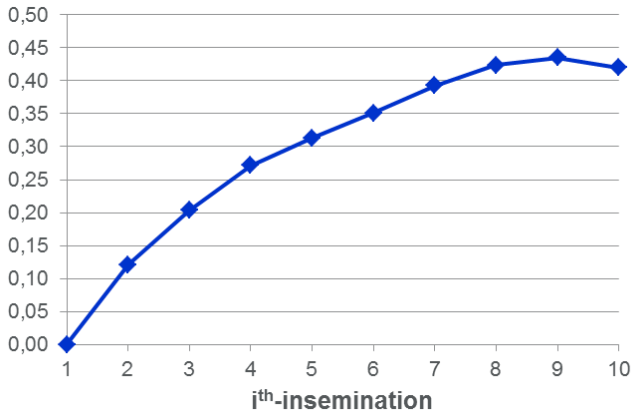
- Necessary to include service number to model the change in expectation if a cow failed to conceive
  - Removed over-estimation of the environmental trend
  - Corrected genetic trend estimates
  - Resulted in smaller estimated heritabilities
- Validated with a simulation study: Muuttoranta et al. 2016 EAAP

Fixed effects solutions:

Insemination year x month



Service number



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Modeling sexed semen

- Prevalence of use: DNK > FIN > SWE
  Jersey > Holstein > RDC
  heifers > cows
  first > second > third service

Use of sexed semen in DNK Jersey

Parity	Prevalence,%
0	7.7
1	3.9
2	3.5
3	2.8

Service number	Prevalence,%
1.	6.2
2.	4.2
3.	2.1
All	4.8

Applied genetic parameters for CR

Heritability		
Parity	**Holstein**	**RDC/Jersey**
0	0.010	0.010
1	0.025	0.020
2	0.030	0.023
3	0.030	0.025

Genetic correlations: Holstein above, and RDC/Jersey below diagonal

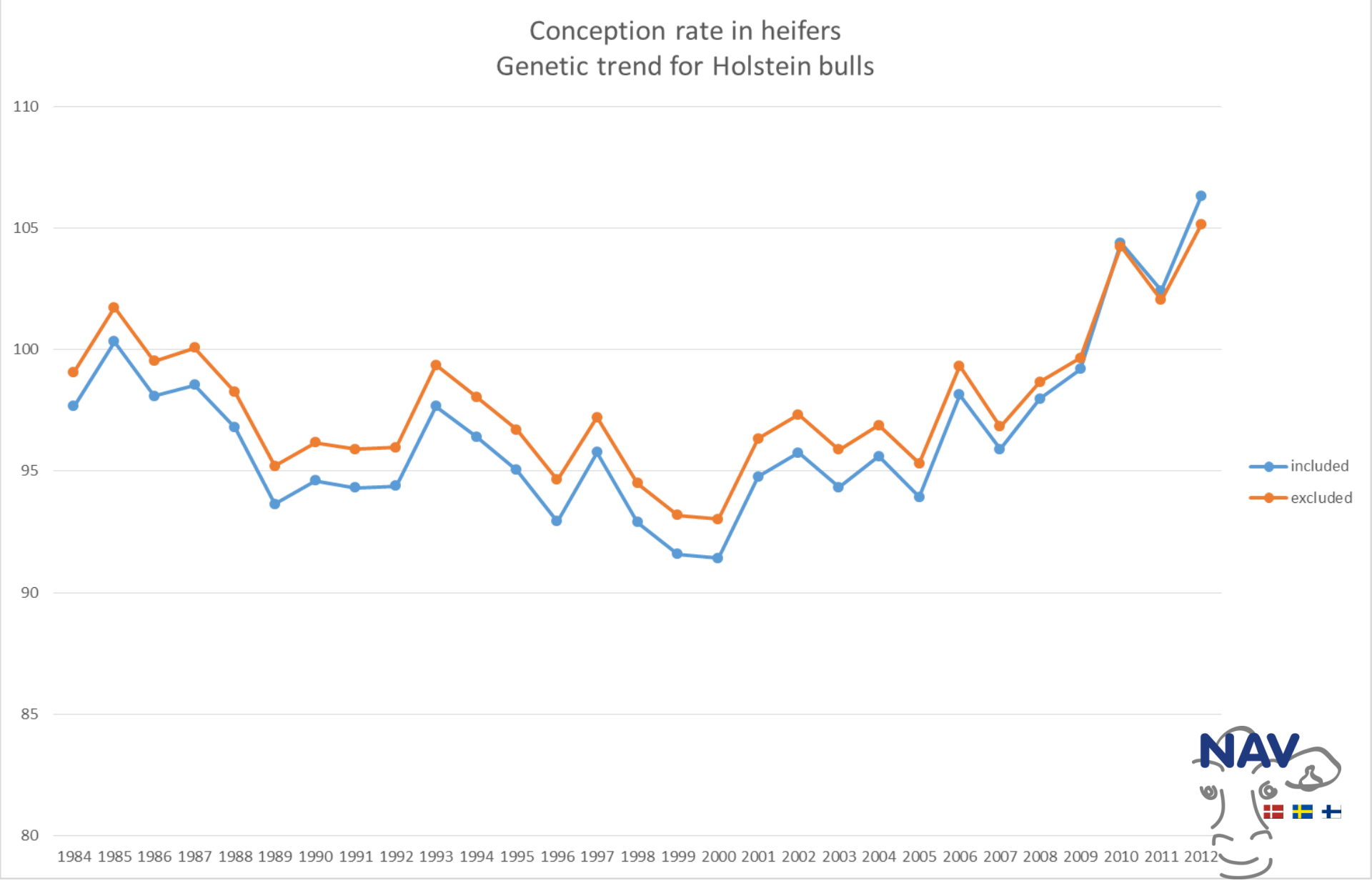
	CR0	**CR1**	**CR2**	**CR3**
CR0		0.72	0.55	0.53
CR1	0.65		0.93	0.92
CR2	0.57	0.93		0.96
CR3	0.47	0.84	0.95	

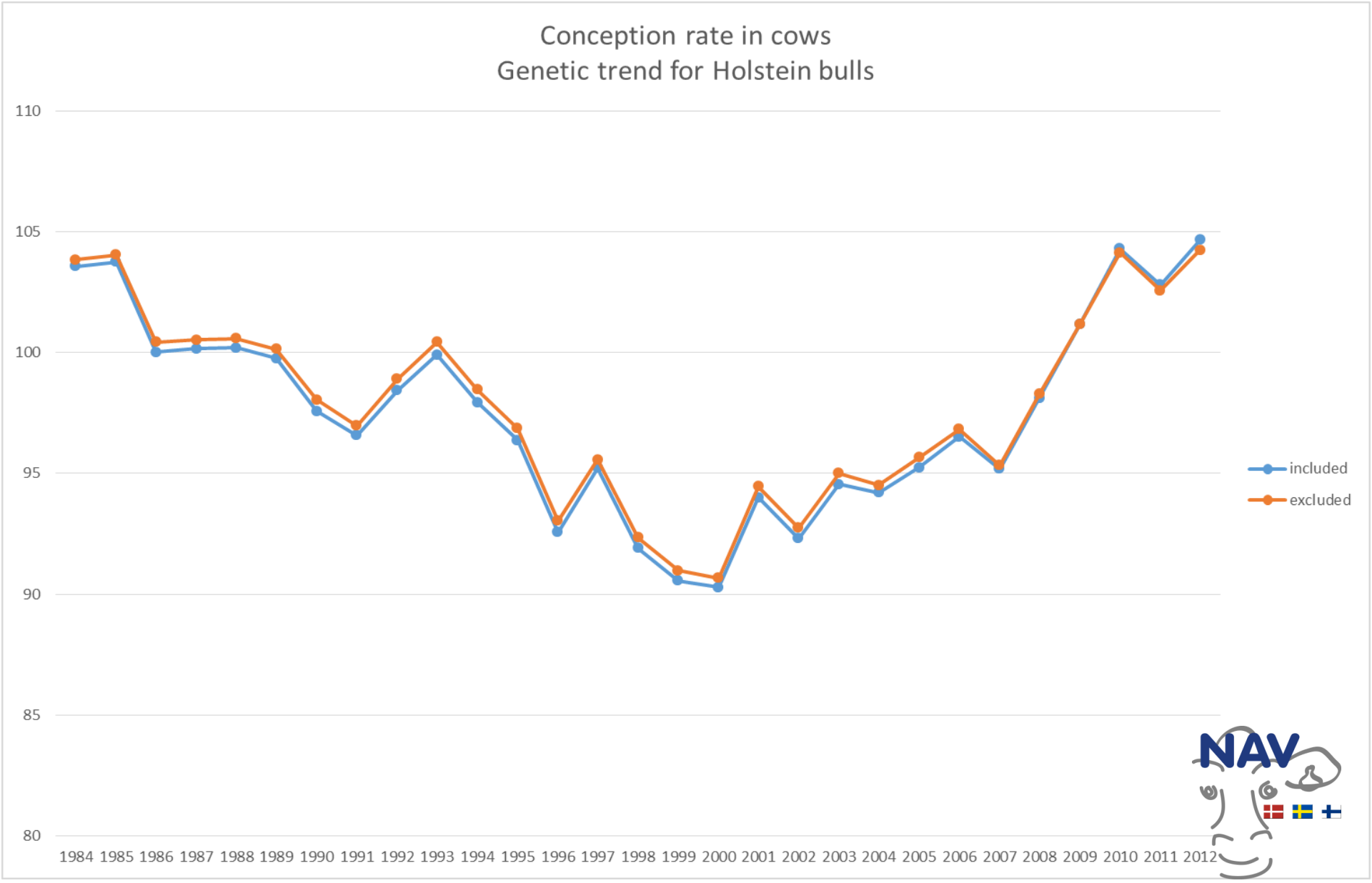
Results

Phenotypic means and distribution of CR observations

Phenotypic means			
Parity	**Holstein**	**RDC**	**Jersey**
0	0.59	0.58	0.57
1	0.44	0.45	0.47
2	0.41	0.43	0.47
3	0.40	0.42	0.46
Cows	0.42	0.44	0.47

- Around 95% of the CR observations were recorded within the:
  - first 3 service for heifers
  - first 4 service for cows
- Phenotypic means and distribution of observations differed among countries





Example:
EBVs of top 1 progeny tested Jersey bull

Modelling sexed semen effect	CR0	CR1	CR2	CR3
Included	110	102	101	101
Excluded	107	98	99	99

Summary

- NRR is replaced by CR in Nordic genetic evaluations for female fertility
- Essential to include service number in the CR model
- Modeling sexed semen effect important:
  - Use of sexed semen becomes more popular
  - Biased genetic trends and EBVs if not accounted for
- Genetic trends of CR are improving for all breeds in the Nordic countries

Thank you!