Building up a reference population for new (and old) traits

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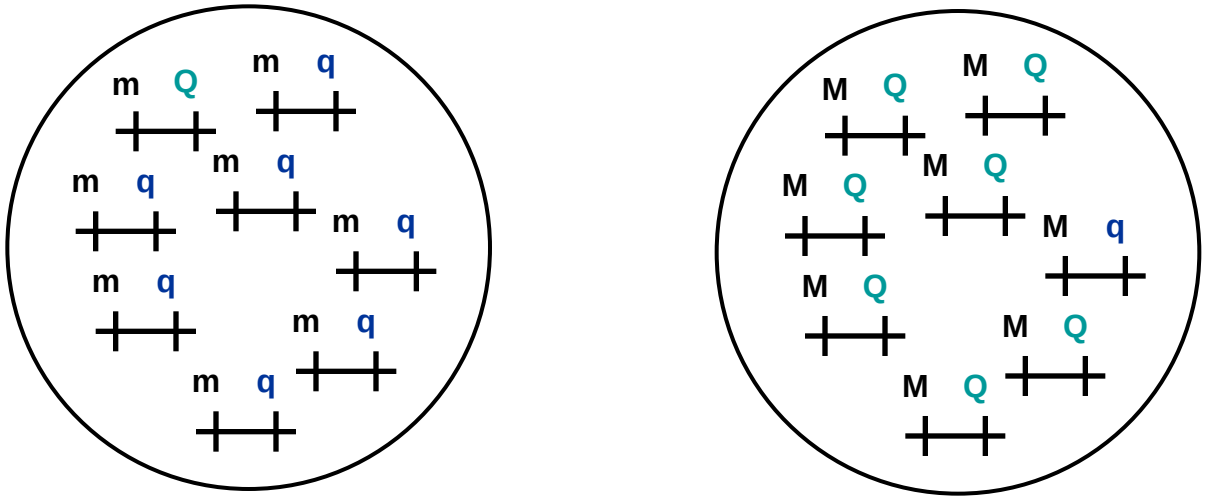
The reliability of the DGV

- The reliability of the DGV depends on:
  - The heritability of the trait or the reliability of the EBV for the bulls
  - The number of genotyped animals with phenotypic records
  - The number of markers (3K, 50K, HD)
  - Linkage disequilibrium

DGV = Direct Genomic Value, EBV = Estimated Breeding Value

Linkage disequilibrium

Allele Q is favorable

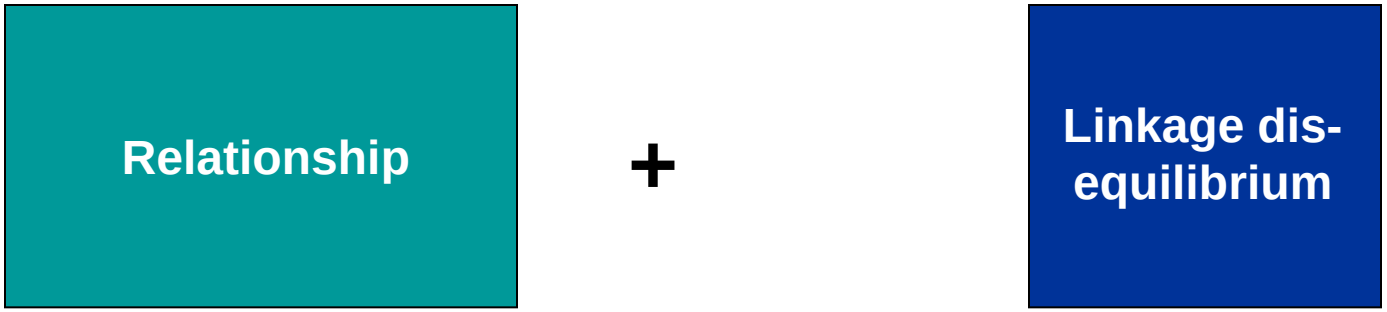


The reliability of the index

In this study

The reliability of the DGV

The reliability of the index =



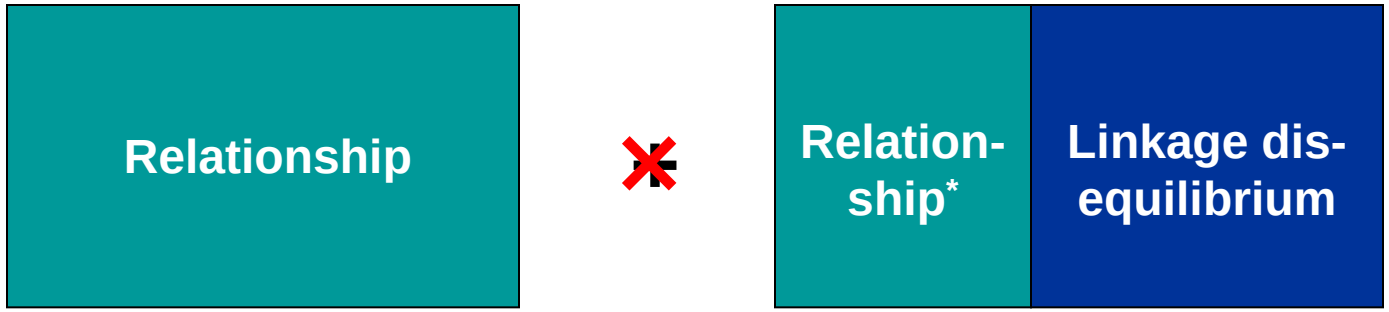
DGV = Direct Genomic Value

The reliability of the index

In reality

The reliability of the DGV

The reliability of the index =



* That can be explained by markers

DGV = Direct Genomic Value

Recording of new traits

- New (often functional) traits
- New traits are probably only recorded on a smaller part of the population
- Fewer bulls get daughters with phenotypic records

Recording on a large scale

- Every year the reference population is added:

  B30: 30 bulls with 500 daughters

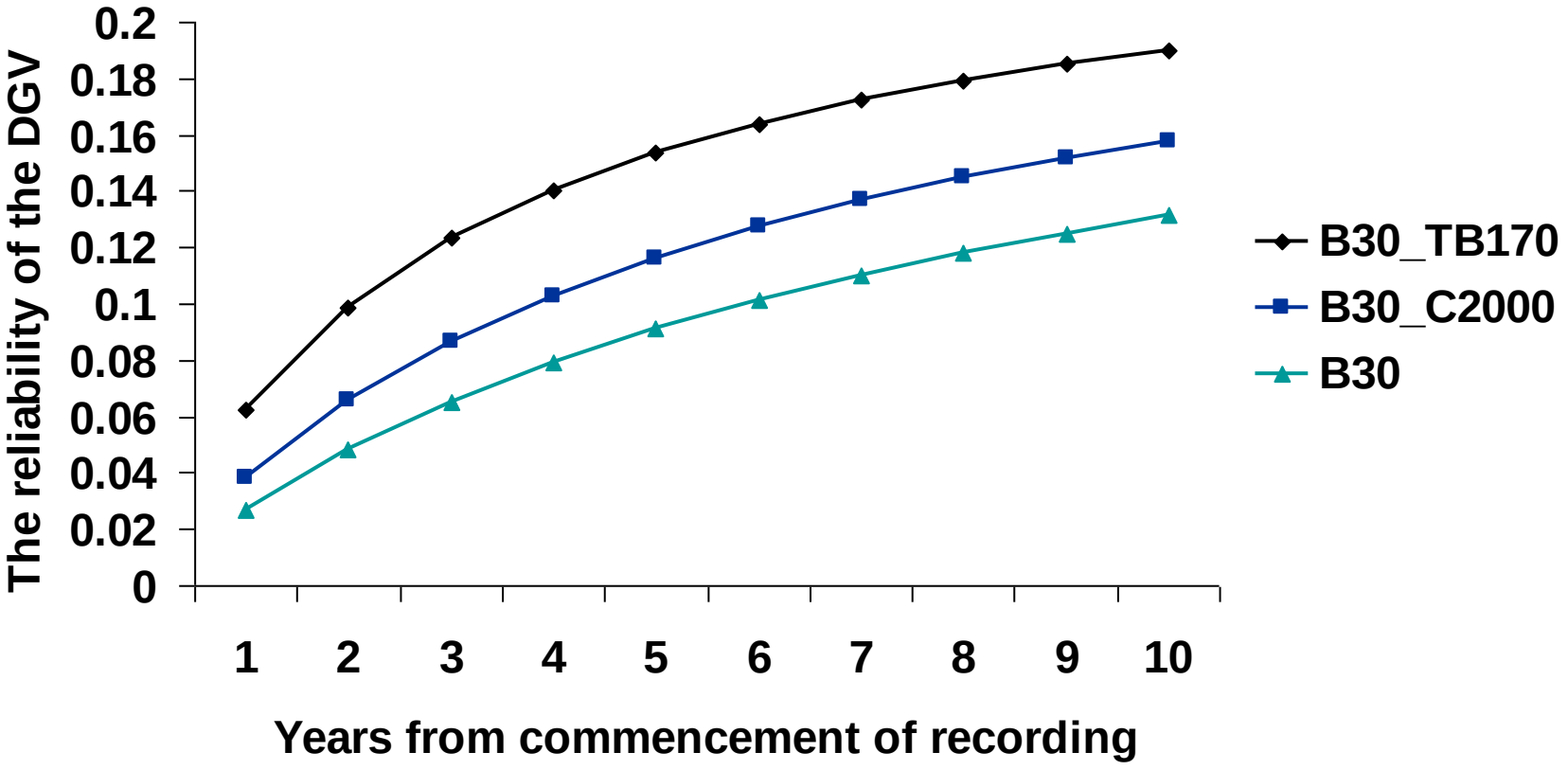
  B30_C2000: 30 bulls with 500 daughters and 2000 cows with phenotypic records

  B30_TB170: 30 bulls with 500 daughters and 170 test bulls with 100 daughters

General assumptions

- Heritability of 0.05
- 38,000 informative markers (50K)
- Turbo scheme – the bulls are used for breeding purposes as soon as they reach sexual maturity

The reliability of the DGV if the new trait is recorded on a large scale



Cows versus (test) bulls when $h^2 = 0.05$

Reliability	0.15	0.20	0.25
Bulls with 500 daughters	414	1,150	12,000
Test bulls with 100 daughters	1,340	3,730	39,000
Cows	57,700	160,500	1,680,000

× 43

Cows versus (test) bulls when $h^2 = 0.30$

Reliability	0.15	0.20	0.25	
Bulls with 500 daughters	73	204	2.100	
Test bulls with 100 daughters	333	925	9,700	× 21
Cows	7,100	19,700	205,000	

Recording on a small scale

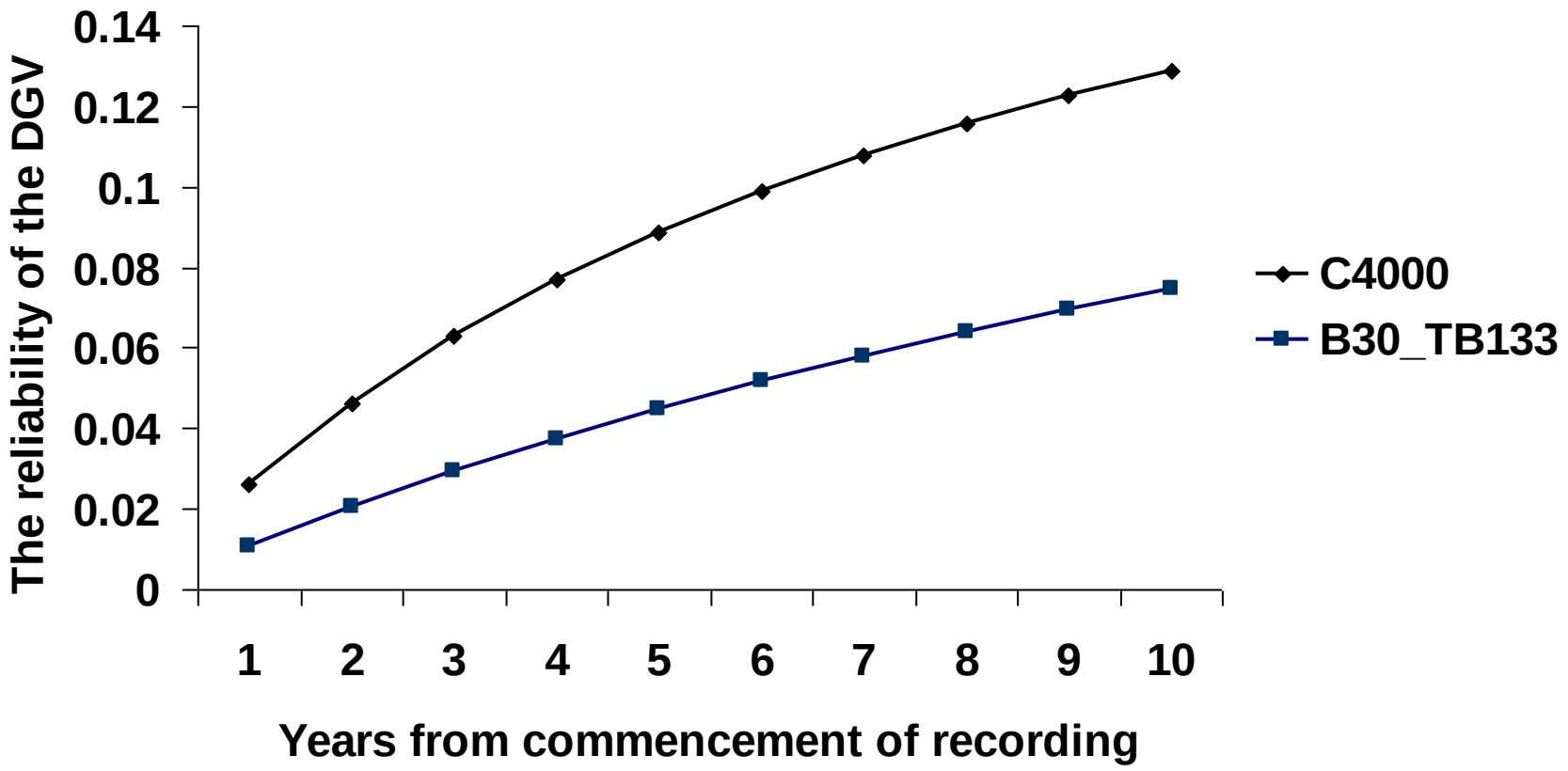
- Every year the reference population is added:

  C4000: 4000 cows with phenotypic records

  B30_D133: 30 bulls with 133 daughters

- $h^2 = 0.05$
- 38,000 informative markers
- Turbo scheme

The reliability of the DGV if the new trait is recorded on a small scale



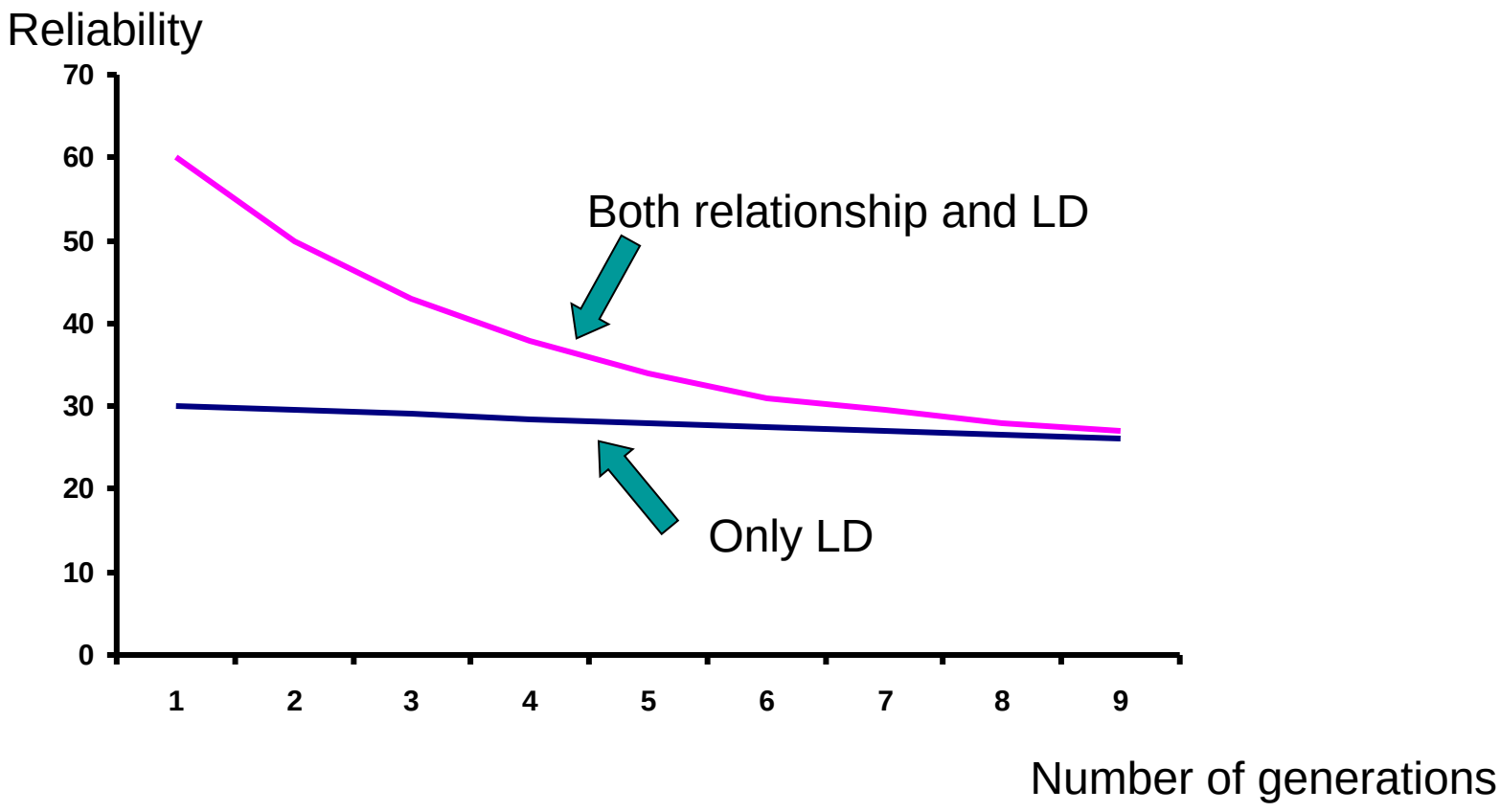
Recommendations for new traits

- Lower reliability of the DGV for new functional traits
- Great value of including more animals in the reference population than the elite bulls

But what about ”old” traits?

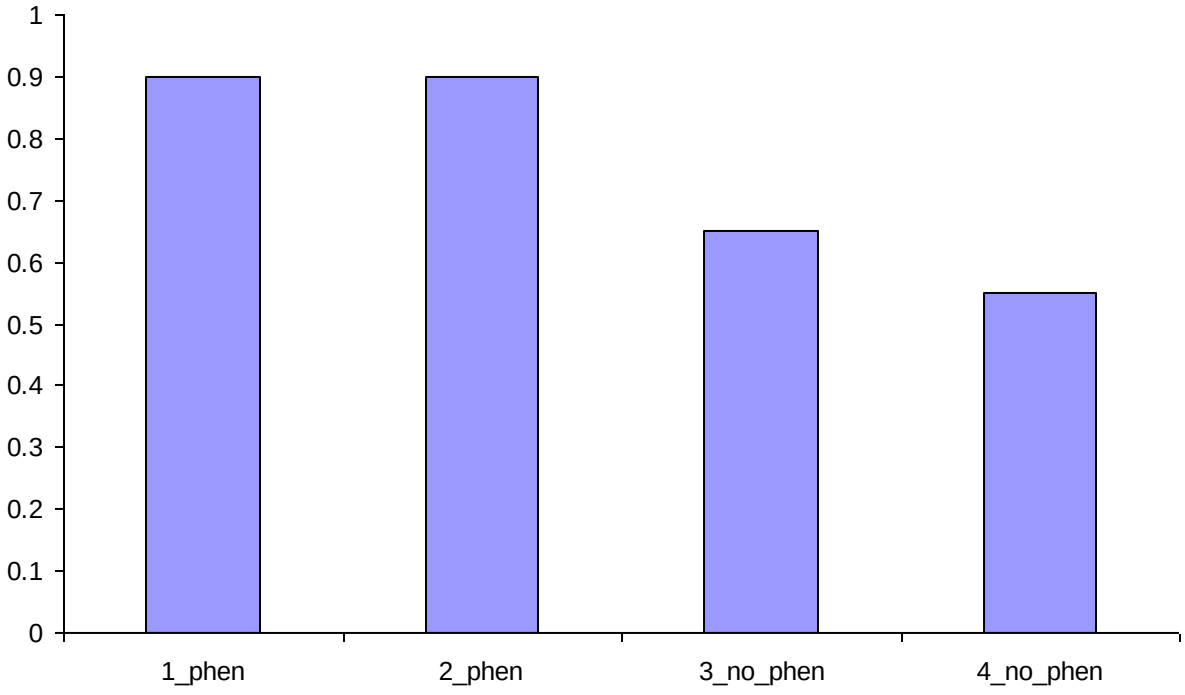
- Assumptions
  - The existent reference population gives 60% DGV-reliability
  - Stop for collection of phenotypes for both cows and bulls.

Reliability depends on both LD and genetic relationship



An illustration

Reliability drops when phenotypes are missing



Modified after Calus et al., 2010

Reasons

- From gen. 2 to gen. 3: The animals themselves are not included in the reference population
- From gen. 3 to gen. 4: The animals are less related to the reference population.

The reliability drops, when pheno-types are missing (Nordic results)

	$R^2_{DGV,EBV}$	
	Sire included in the reference population	Sire not included in the reference population
Fertility	0.41	0.33
Protein	0.41	0.36
Udder health	0.44	0.34

Lund et al., 2009

Conclusion

- Registrations are continuing necessary
  - To achieve high DGV-accuracy for ”new” traits
  - To sustain/enhance DGV-accuracy for ”old” traits
- Still recommended to progeny test bull for strengthening the reference population
- Acceptable accuracy for DGV’s for new traits are achieved as fast as possible with cows in the reference population
- Genomic test strategy is dependent on test price (males versus females)

Practical considerations with use of GenVikPlus (GV+) bulls

Morten Kargo

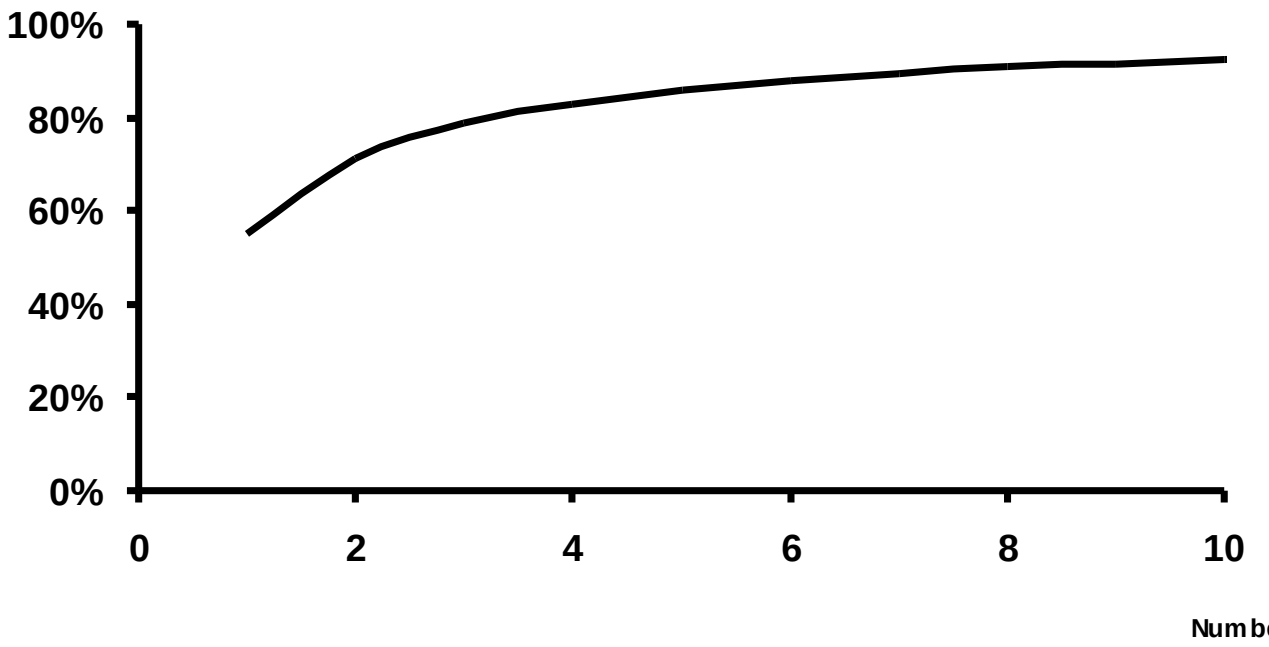
The on farm challenge is the lowered accuracy (compared to proven bulls)

True breeding value (TB) versus EBV

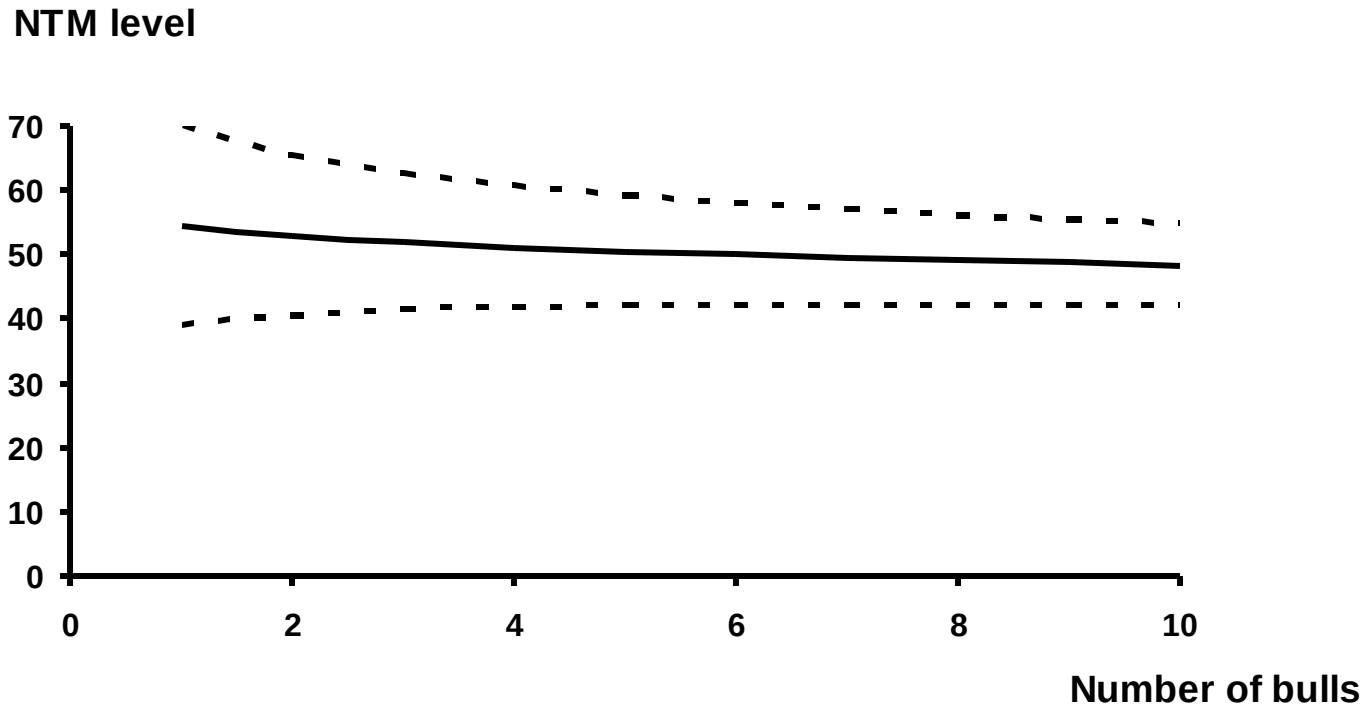
EBV	+ 25 NTM							
Accuracy	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**95%**
TB, min	**+6**	**+7**	**+9**	**+11**	**+13**	**+15**	**+18**	**+20**
TB, max	**+44**	**+43**	**+41**	**+39**	**+37**	**+35**	**+32**	**+30**

Average accuracy **High Accuracy**

NTM accuracy on group mean of GV+ bulls depending on group size



The expected NTM level for the best GV+ bulls



The dotted lines are 95% confidence intervals

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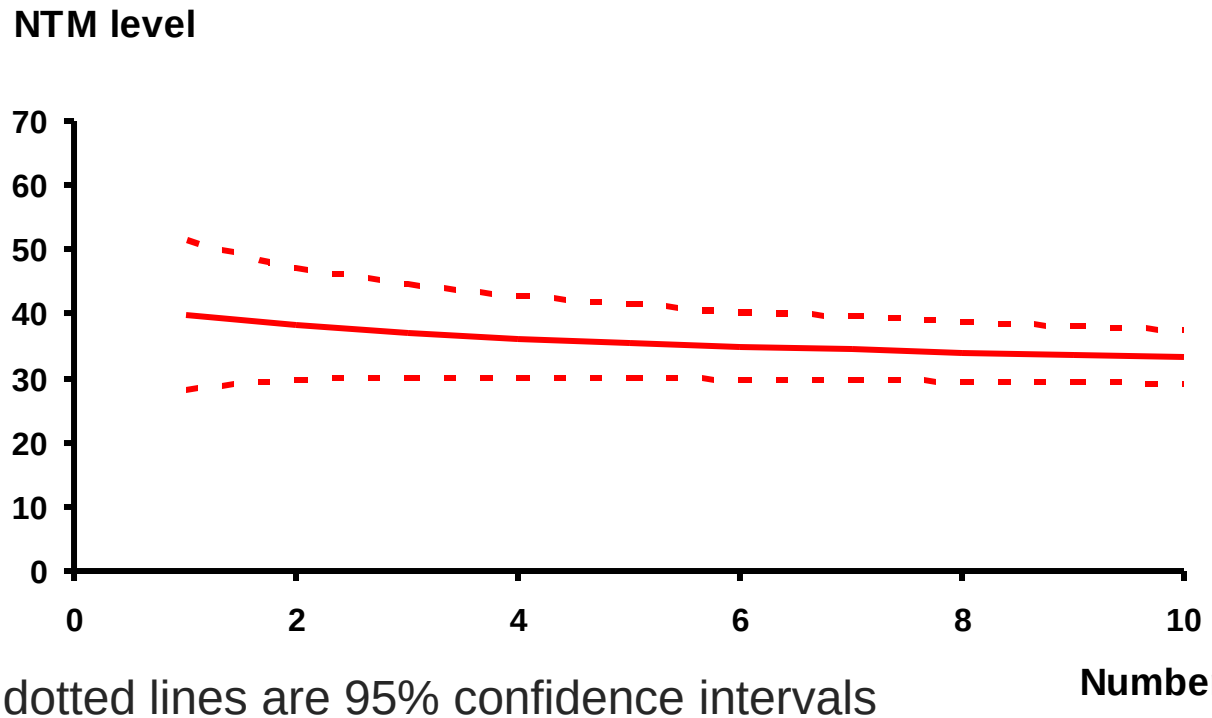
The expected NTM level for the best progeny tested bulls



The dotted lines are 95% confidence intervals

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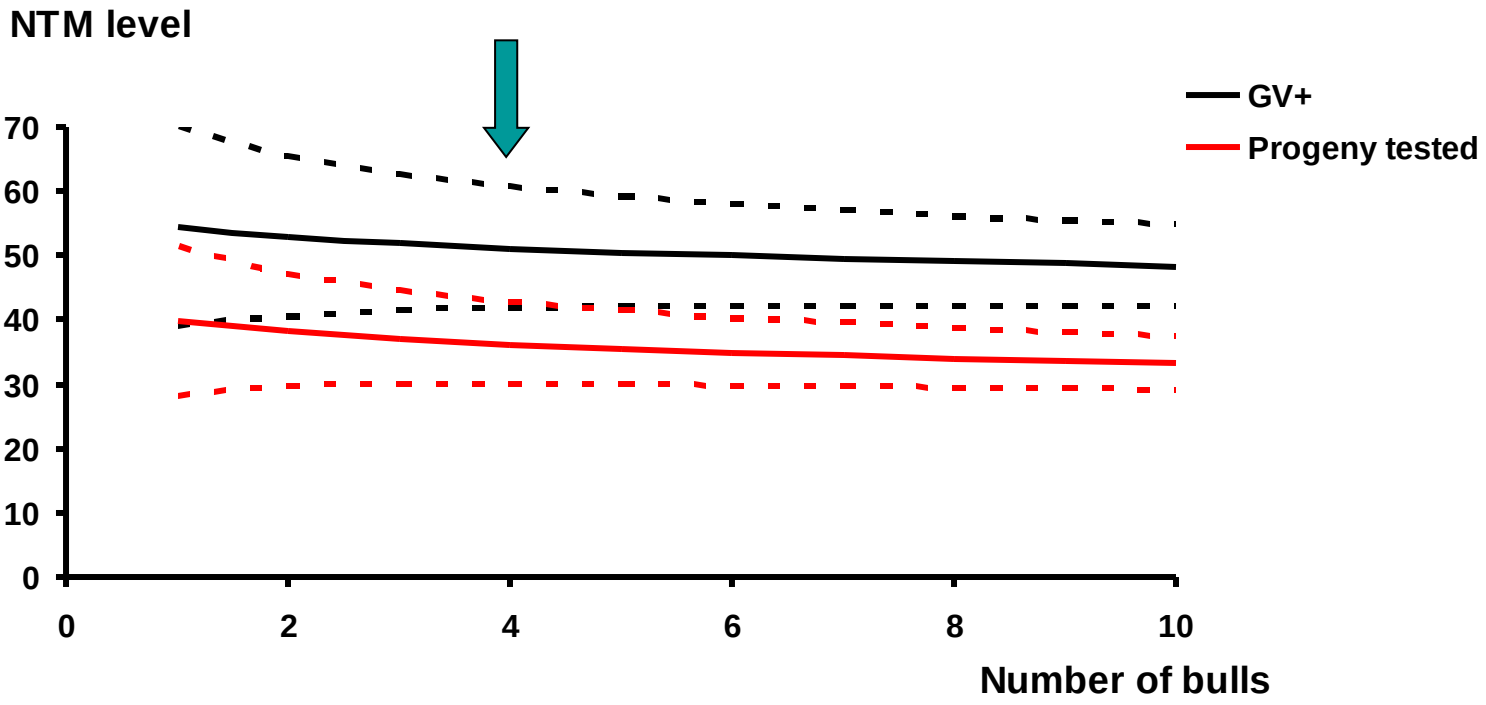
GV+ bulls versus progeny tested bulls



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Value of using GV+ bulls instead of ”traditional” progeny tested bulls

- **On average the difference is 15 NTM units (Holstein)**
- **Economic advantage using GV+ bulls for 100 heifers/cows instead of traditional tested bulls is approximate 7,000 – 8,500 Euro**

Disadvantages

- **Lowered reliability of parent average for young animals**
- **No problem for dairy producers focusing on groups of animals**
- **A problem for breeders focusing on single animals**

Challenges

- **Stop focusing on single animals – also in the presentation of GV+ bulls**
- **GV+ bulls must be considered as a group of bulls**
- **In small herds use only 2-3 doses per GV+ bull**

Practical recommendations regarding bull use for dairy farmers

- **Use 75% GV+ bulls and 25% test bulls**
- **Have intermediate aims – it is a big change for some dairy farmers**

Practical considerations regarding Sires of sons

- **50% GV+ bulls and 50% progeny tested bulls as sires of sons. The argument is based on risk and inbreeding considerations**

Practical considerations – Overall conclusion

- Use of GV+ bulls as sires of cows are in the long term free of risk, and therefore recommended
- There is a risk using only GV+ bulls as sires of sons
  - Is something missed – we are new in the area
  - Inbreeding
- Given today's knowledge: continue progeny testing
- Remember breed differences