The breeding plan and the work for better indices from a global perspective

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Outline

Status and future:

- Breeding goal
- Registrations
- Breeding value
- Breeding plan
- Genetic progress

Breeding values - abreviations

- DGV (SNP effects)
  - Direct Genomic Value
- EBV (phenotypic registrations)
  - Estimated breeding value
- GEBV (SNP effects + phenotypic registrations)
  - Genomic Enhanched Breeding value

DGV & EBV = GEBV

Breeding goal and genomic selection

- B is the same with or without genom

But:

- The composition of the d is different
  - More progress in functional traits relative to yield and type
  - More progress in later lactation relative to first lactation

Genomic selection can give a more balanced genetic progress

Reliability EBVs

Trait	DGV* Birth	Cow-3 year	Bull – 5 year
Yield	40-50%	50%	90%
Fertility	40-50%	22% (PI)	70%
Mastitis	40-50%	25% (PI)	75%

Note the relationship between reliabilities:

Yield versus functional traits

Registrations

Today

- **High quality and lots of data**

Future with genomic selection

- **High quality and lots of data**

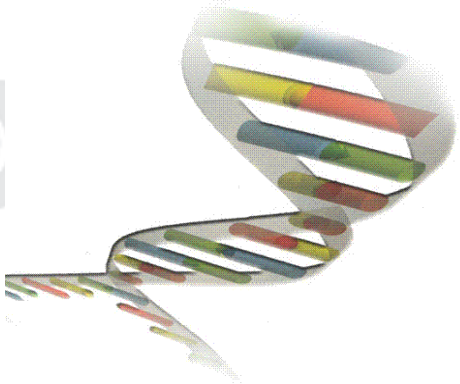
Data from practice will still be the key!!

Today

Bulls with known EBVs and SNPs create the ”DNA-dictionary” (reference pop.)

SNPs ⟷ **EBVs**

SNPs from young animals can be translated to DGVs



HOL 40-50%

JER 30-40%

RDC 25-35%

SNPs from young animals → **Genomic EBVs**

Bulls with known EBVs and SNPs create the ”DNA-dictionary”

The quality of the dictionary is correlated to the size of the <u>reference population</u>

SNPs ⟷ **EBVs**

Bulls with known EBVs and SNPs create the ”DNA-dictionary”

Holstein – Eurogenomics

+12,000 reference bulls

+10% reliability (40 to 50%)

SNPs ⟷ **EBVs**

Bulls with known EBVs and SNPs create the ”DNA-dictionary”

Reference bulls:

16,000 Eurogenomics (HOL)

12,000 US+CDN (HOL)

5,000 Brown Swiss

More cooperations will be established

SNPs ⟷ **EBVs**

Bulls with known EBVs and SNPs create the ”DNA-dictionary”

More reference bulls:

RDC: NRF? or HOL (700K)?

DJ: USJ? or HOL (700K)?

SNPs ⟷ **EBVs**

Future

SNPs
3K,50K,700K
(whole genome)

Phenotypes

Number of animals tested depends on prices:

- **Today in total about 300 Euro**
- **Future prices for 3K, 50K, 700K?**

Future

SNPs ⟷ EBVs

Low prices → Large scale testing/screening

→ Large scale DNA collection

→ DNA available on females with new registrations 3 year ahead!

Future

SNPs ⟷ EBVs

It is time to plan for a large scale DNA collection - the first countries make already plans

E.g.

New registrations available in 2014 – DNA collection has to start in 2011, if it takes place along with ear tagging

Future

Statistical methods will be improved

SNPs ⟷ **EBVs**

Combining of DGV and EBV

- Assumptions
  - DGV is robust it means stabile from evaluation to evaluation also when reference group is updated
  - Fluctuations in DGV will give fluctuations in GEBV and in worst case raise doubts about genetic evaluation in general

Stability in DGVs are needed

Combining of DGV and EBV

- **Assumption**
  - **We need to know the reliability on DGV and EBV to be able to combine in an optimal way.**
  - **Critical because we want to compare animals with different information – bulls at 5 year with 100 daughters versus bulls 1 year with genotypic information only.**

Estimation of reliabilities for DGV – R&D is still needed

What is included in DGV?

- Lots of pedigree information, which also are in traditional parent average index
- Important information about mendelian sampling

NAV's plan

1. Test the methods on fertility and yield on Holstein data
2. Participate in Interbulls test run with GEBV's in sep (Holstein only)
3. Combine PA og DGV for young genomic tested animals and change from unofficial DGV's and official EBV's (today) to official GEBV's (autumn 2010)
4. Blend DGV in the traditional EBVs for all animals (during 2011)

INTERBULLS plans for international evaluation based on EBVs including genomic information

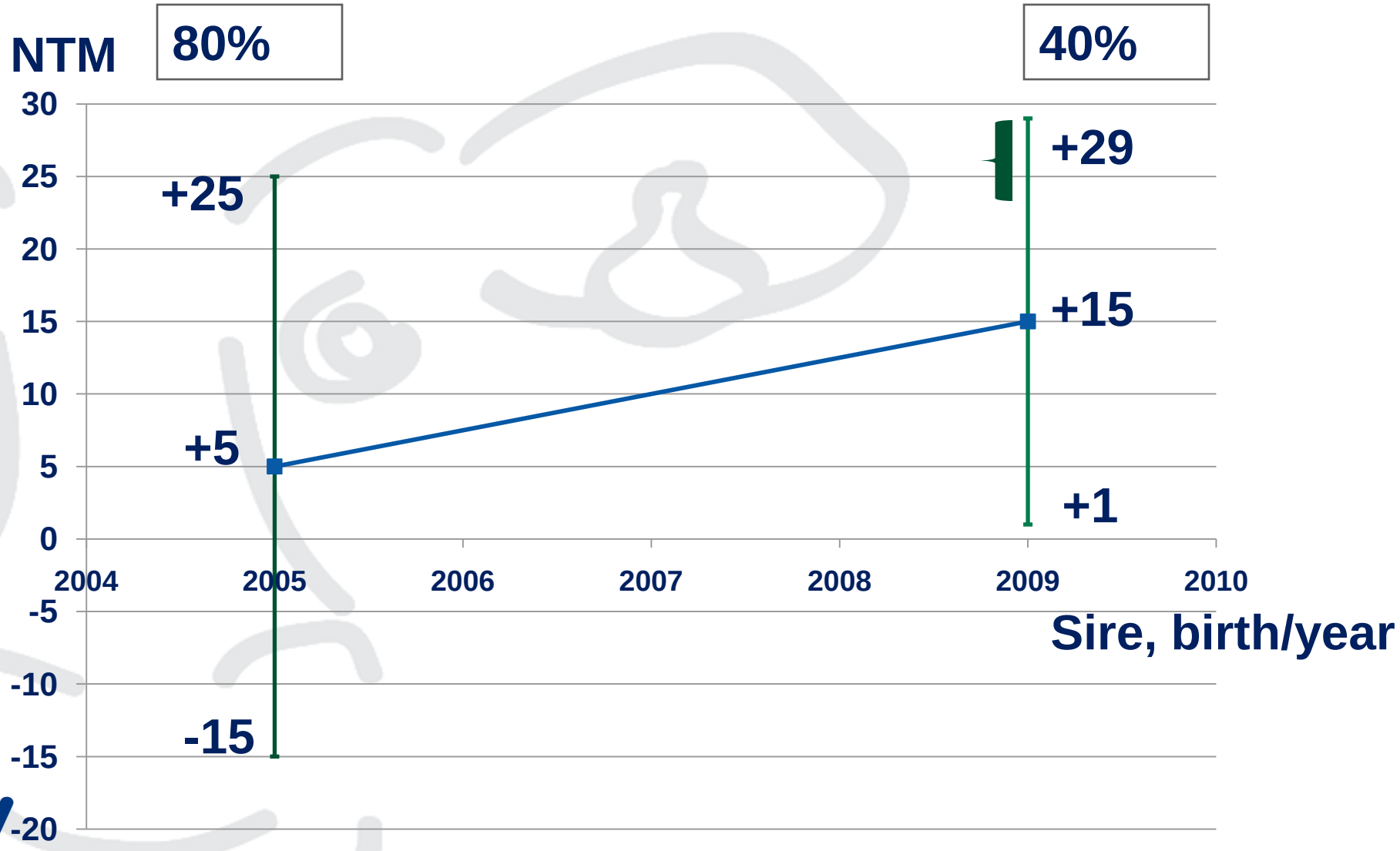
Time schedule	What will happen?
Spring 2010	Data delivered – 7 countries
	GMACE ready
	Pilot run GMACE
June 2010	Discussion of GMACE results
	Validation criteria ready
Sep 2010	GMACE test run
Dec 2010	GMACE routine run

Reliabilities, NTM

	Yesterday	Today	Future
5 year old bulls	80%	80%	
3 year old bull dams	35%	35-55%	
Heifer and bull calves	25%	30-50%*	Higher*

* With GS

Variation in NTM among bulls



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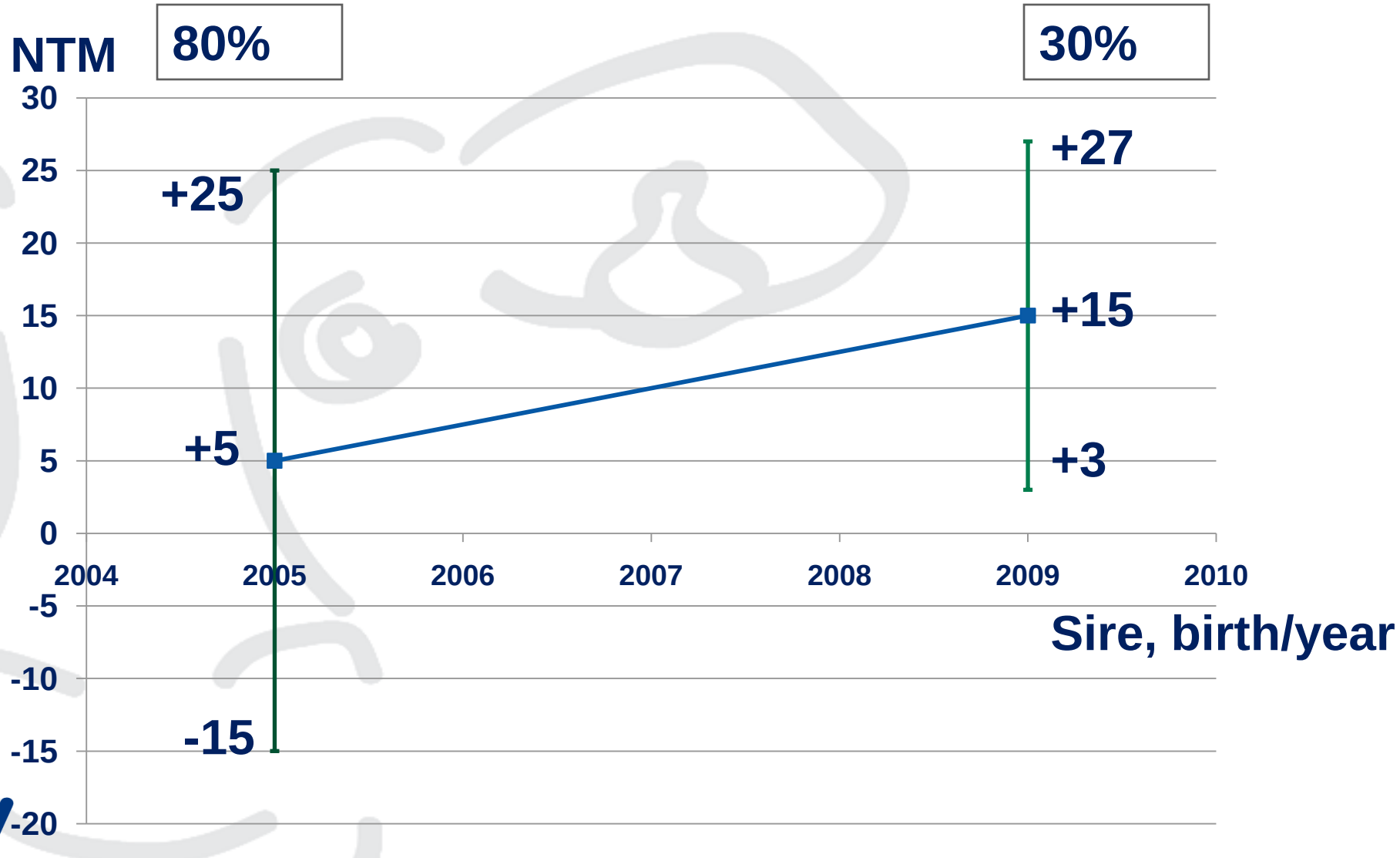

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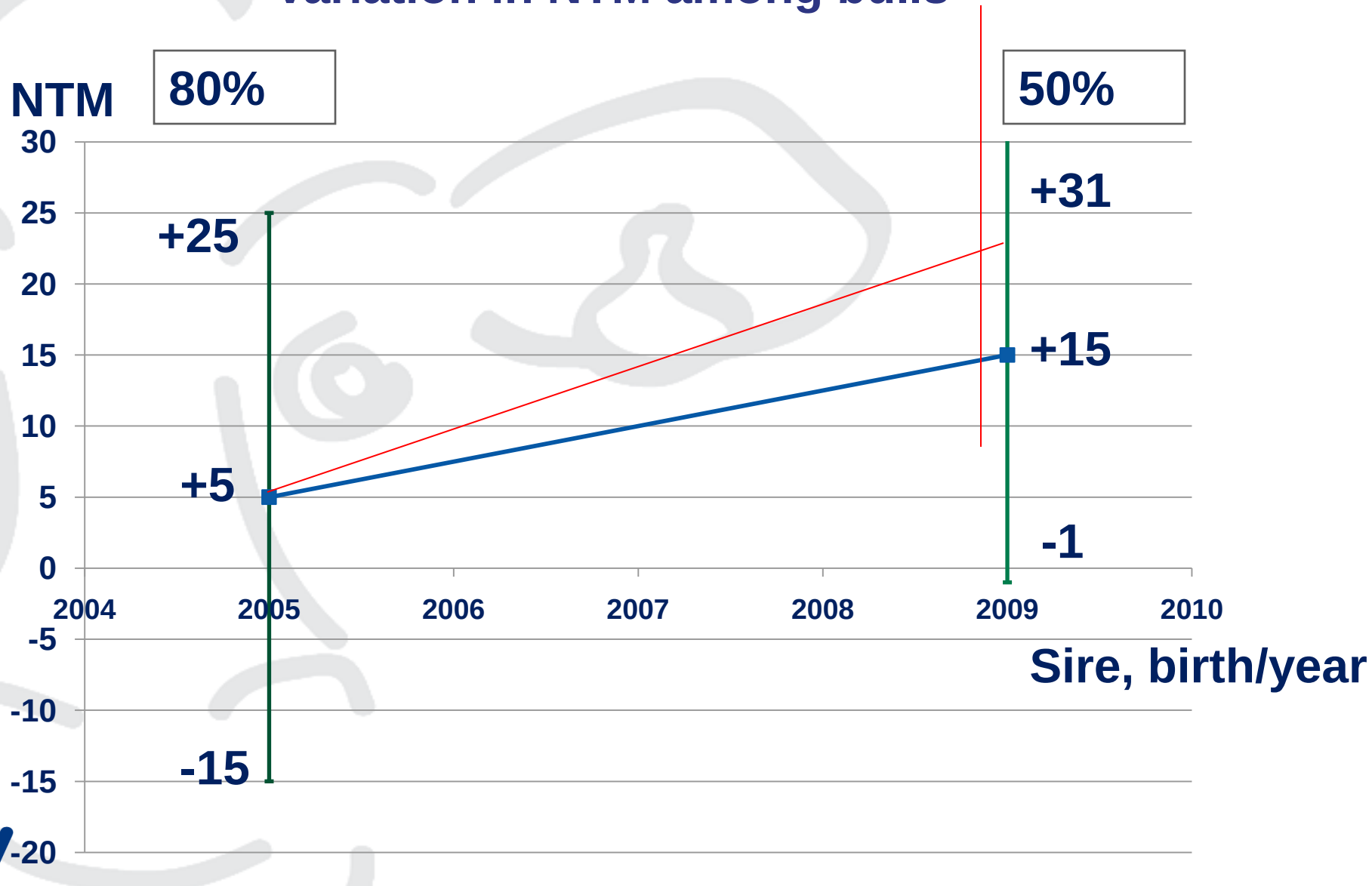
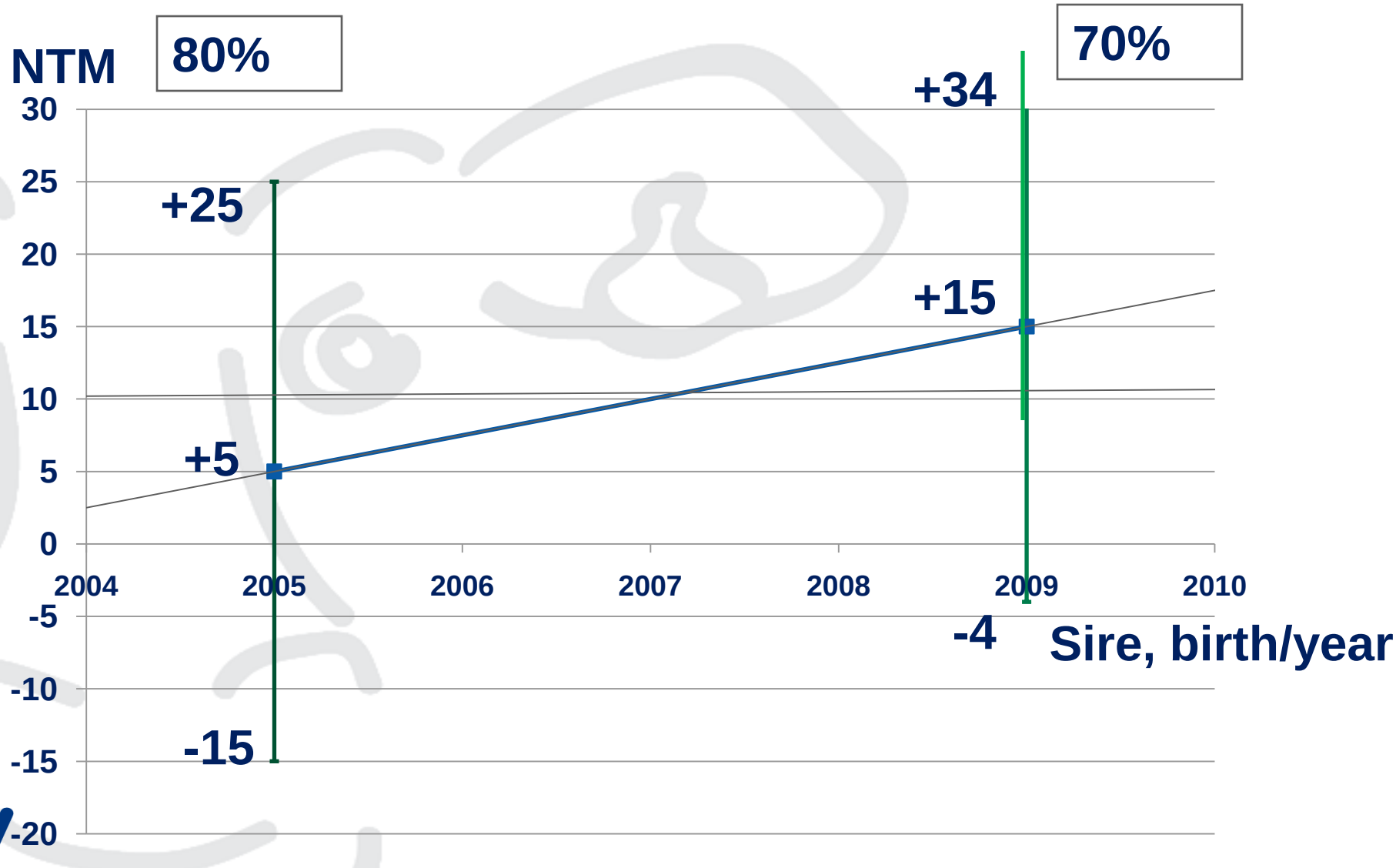


Future variation in NTM among bulls



True breeding values versus EBVs

EBV	+25 NTM							
Reliability	30%	40%	50%	60%	70%	80%	90%	95%
Min	+6	+7	+9	+11	+13	+15	+18	+20
Max	+44	+43	+41	+39	+37	+35	+32	+30

Low reliabilities means large standard errors (min-max)
Do not use the single bulls too intensive, but use more bulls with nearly the same DGV

Breeding plan

	Yesterday	Today	Future
Bull sire and Proven bulls	5 year old >100 daughters	Mixture (1 and 5 year) depending on reliability of GS	1 year old
Bull dams	Mainly lactating cows	Mixture (age classes) depending on reliability of GS	Mainly heifers

Reliability 30% → **Reliability 50%**

Breeding plan

Use of semen	Yesterday	Today	Future
% Proven bull	70%	50%	0%
% Genvik plus bull	0%	30%	80%
% Young bull	30%	20%	20% (Ref)

Selection of Genvik plus bulls depends on reliability of DGV:

- **Higher reliability stronger selection**
- **Lower reliability use relatively more bulls as Genvik plus**

Genomic test of animals

- Advantage to test both bull calves and female candidates – more bull calves than females
- 5-6 times the number of selected animals a good starting point
  - Trade off – money and response
  - Progress per test decrease by increasing number of tests, but total progress increase still!

2010

- More balanced and higher genetic progress
- Genomic EBVs have higher reliability than pedigree index but lower than progeny – take care in practice – see Genvik plus bulls as a team
- Genomic prediction has a short history and is still under development – has to be remembered in practice
- Official EBVs will include genomic information in 2010
- Breeding plan will gradually change – shorter generation intervals

Future

- "GS technology" will improve further – cheaper more K's
- Genomic EBVs will be more reliable
- Breeding animals young animals mainly
- More cooperation across countries/organisations
- Interbulls role might change
- Collection of DNA from all/lots of animals will be standard in the near future – 3K might initiate it
- We need to start thinking/test how to do it
- Still lots of high quality phenotypic registrations are needed – it is the key