



Genomic selection breeding programs

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Breeding programs must be designed to:

1. Facilitate effective use of the breeding values.
 2. Create the data needed to perform the breeding value estimation
- A change in breeding value estimation methods thereby change the optimal design of the breeding program.

Genomic selection

- Facilitates:
 - Selection for traits not measured on candidates
 - More accurate selection at a younger age
- Adds another cost component

Simulation studies - assumptions

- Stochastic individually genome based simulations
- ABLUP or GBLUP
- Moderate marker density
- 10-20 years of selection
- Polygenic and normally distributed traits

- Accuracy is an output of the simulation, depends on breeding scheme



Example 1 – dairy cattle

Challenge: Select males for traits measured on females

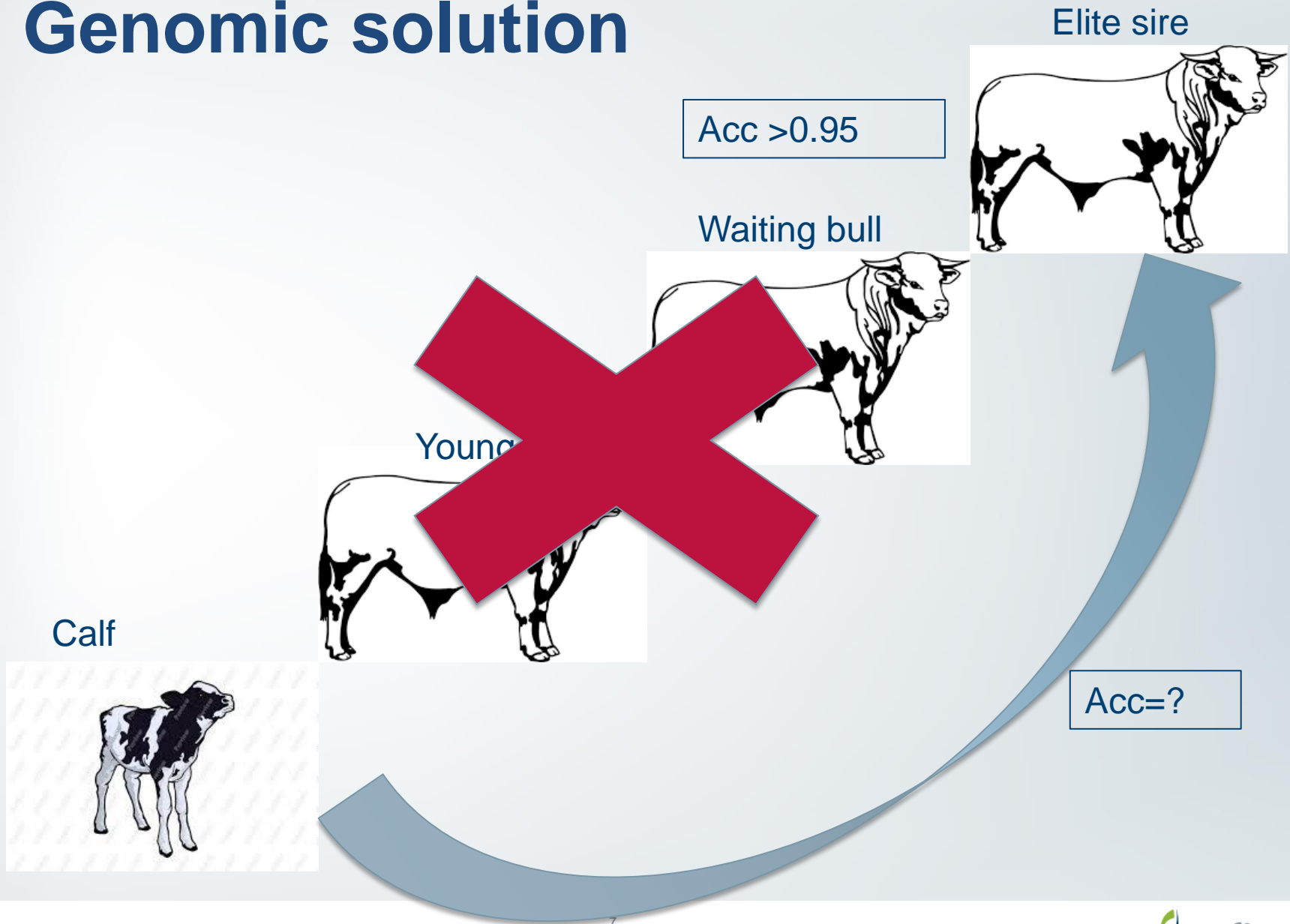
The conventional solution

- progeny testing

1. Selection of young bulls to be progeny tested
2. Obtain daughters of young bulls and wait for them to get milk records
3. Select elite sires based on progeny performance



Genomic solution



Elite sire

Acc > 0.95

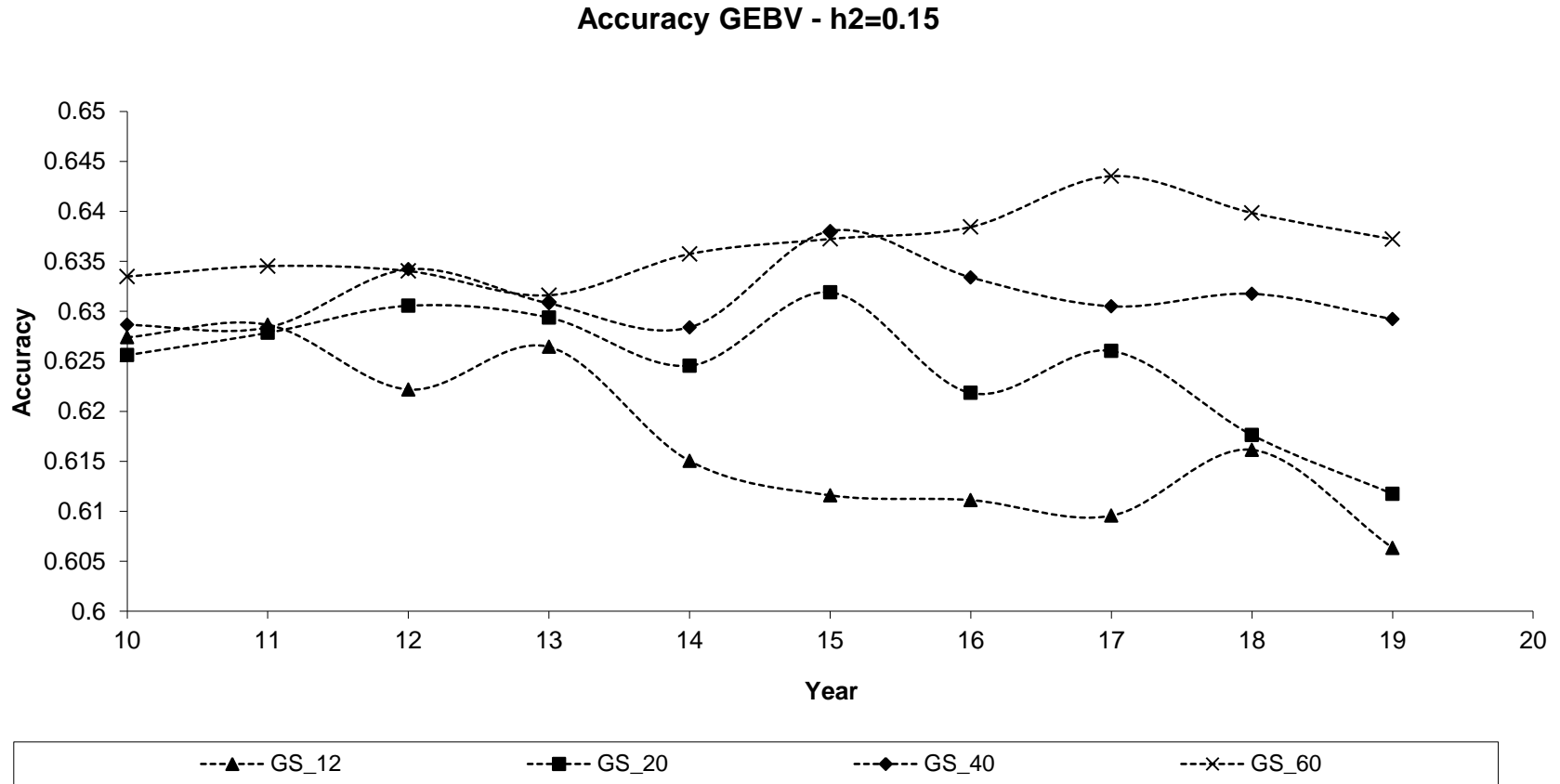
Waiting bull

Young

Calf

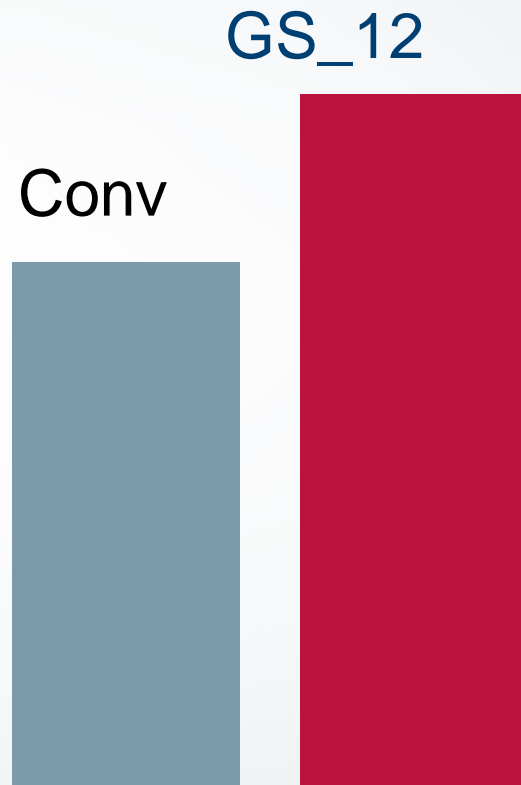
Acc = ?

Accuracy of selection

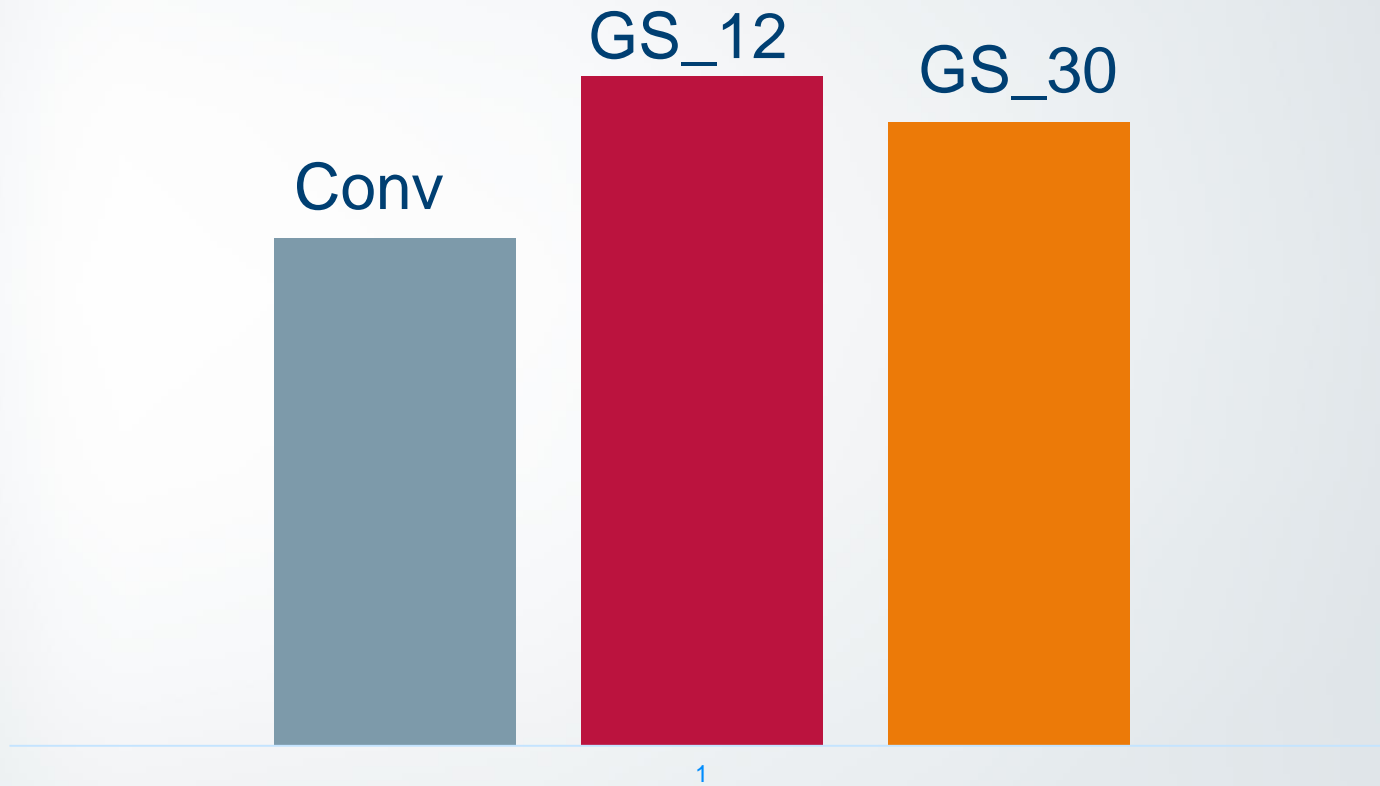


Lillehammer et al., 2011, J. dairy sci.

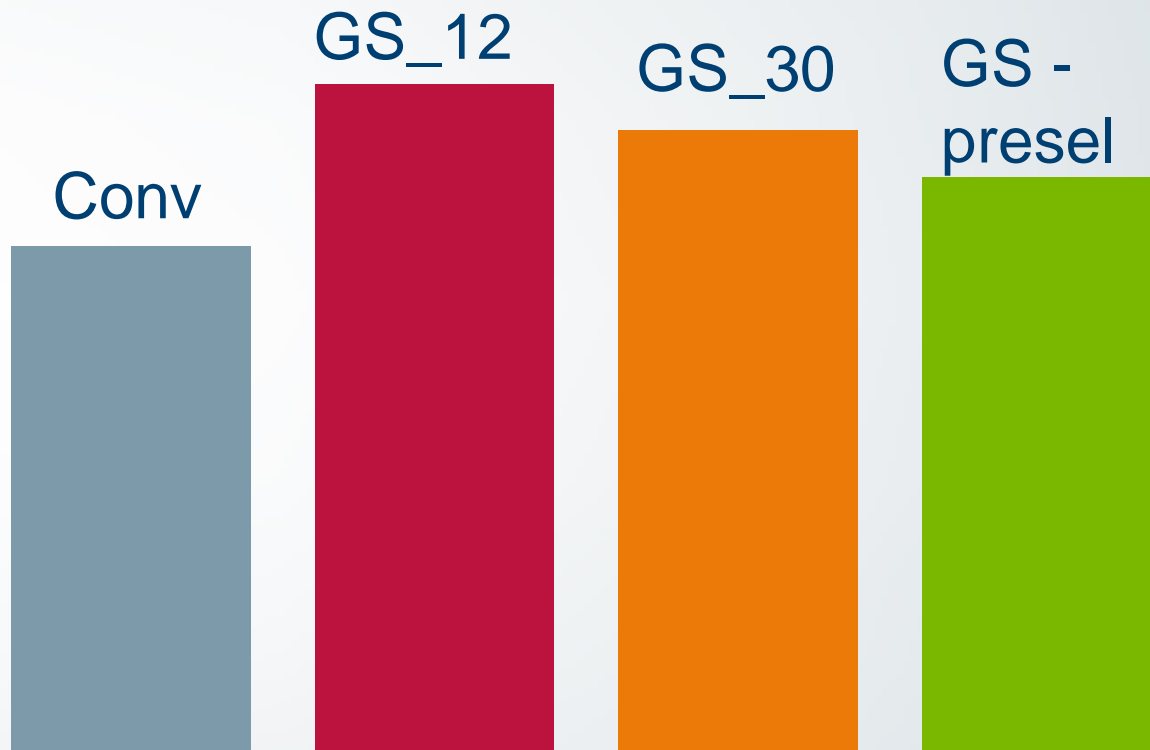
Genetic gain



Genetic gain

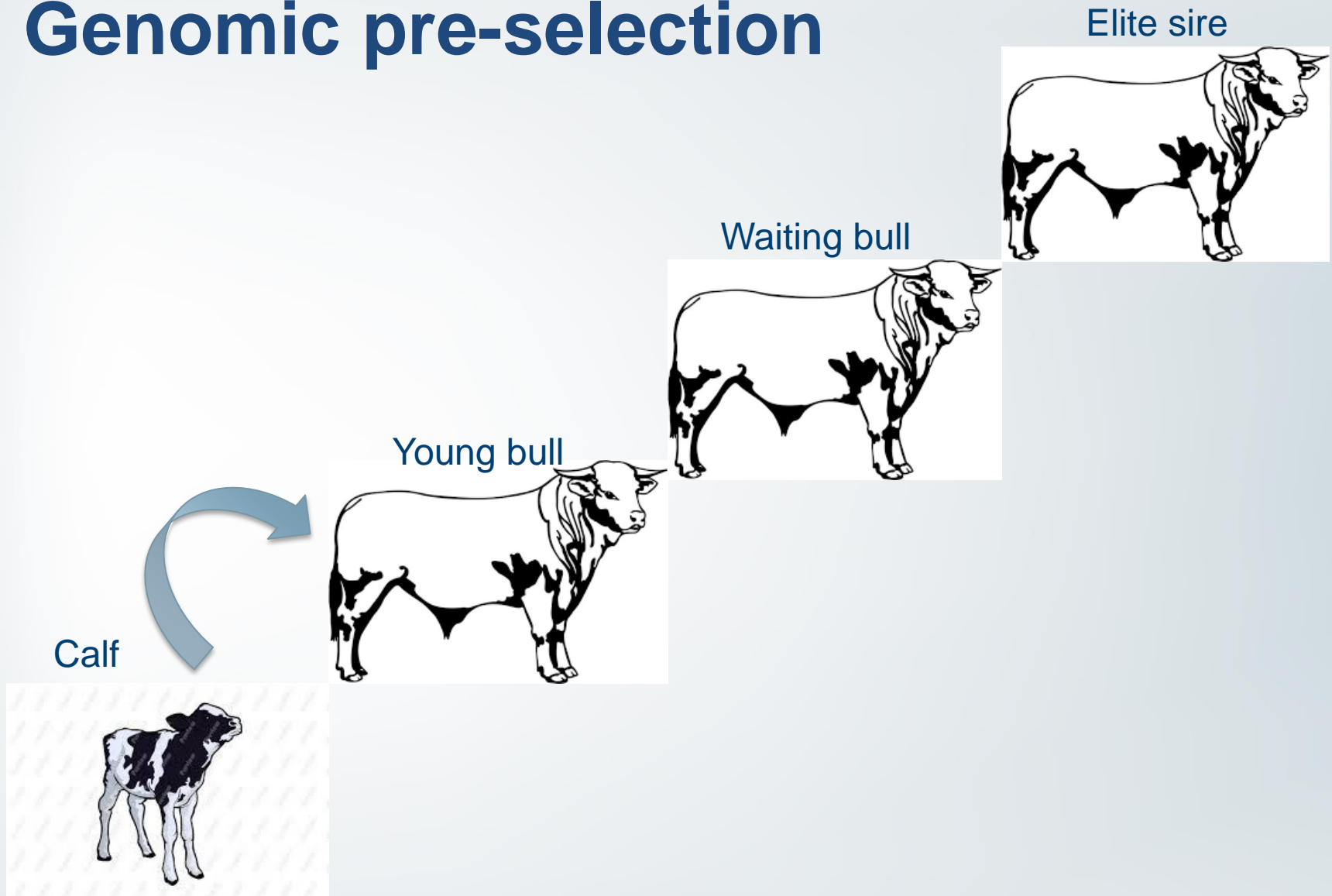


Genetic gain



1

Genomic pre-selection



Take home message:

- Remember to incorporate in the breeding program how the reference population should be updated



Example 2: maternal pig breed

Challenge: multiple traits with different information content

Breeding goal maternal pig breed

- Two main categories of traits
 - Measured on candidates: growth-related traits
 - Measured on sibs: maternal traits (and slaughter traits)
- In a conventional breeding program, most of the genetic gain will come from the first trait category

Selection for two traits: genetic gain



CAND - trait

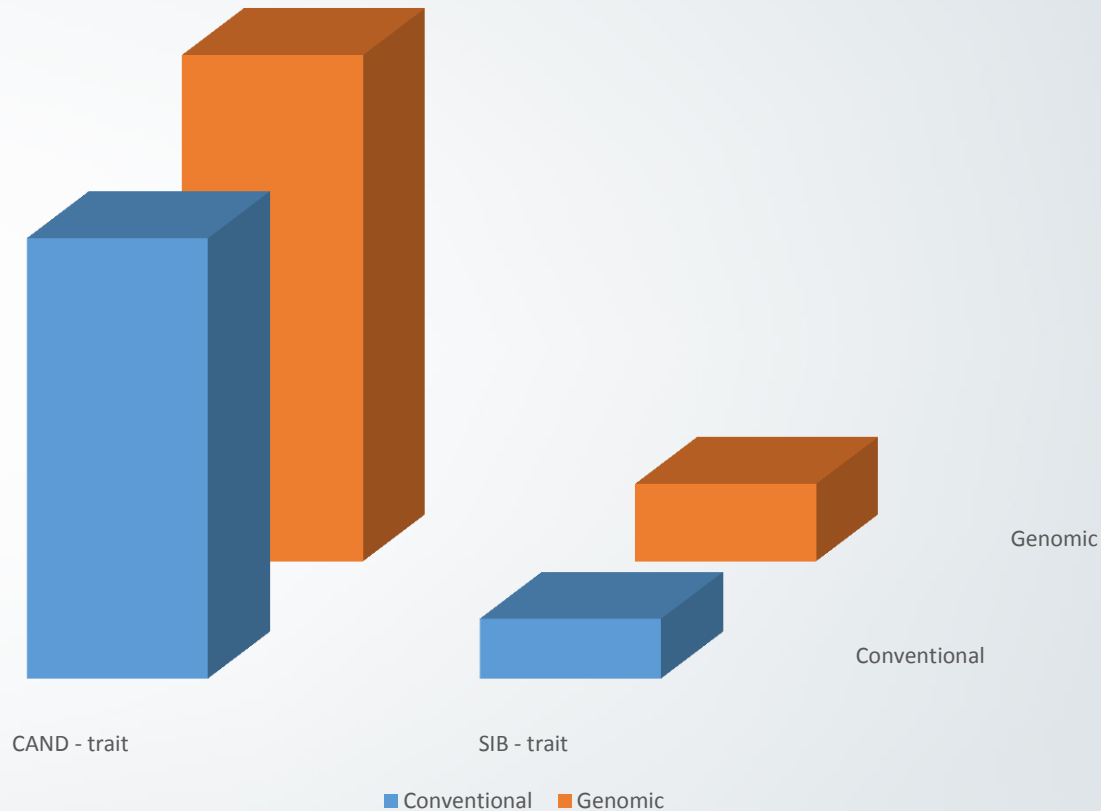


SIB - trait

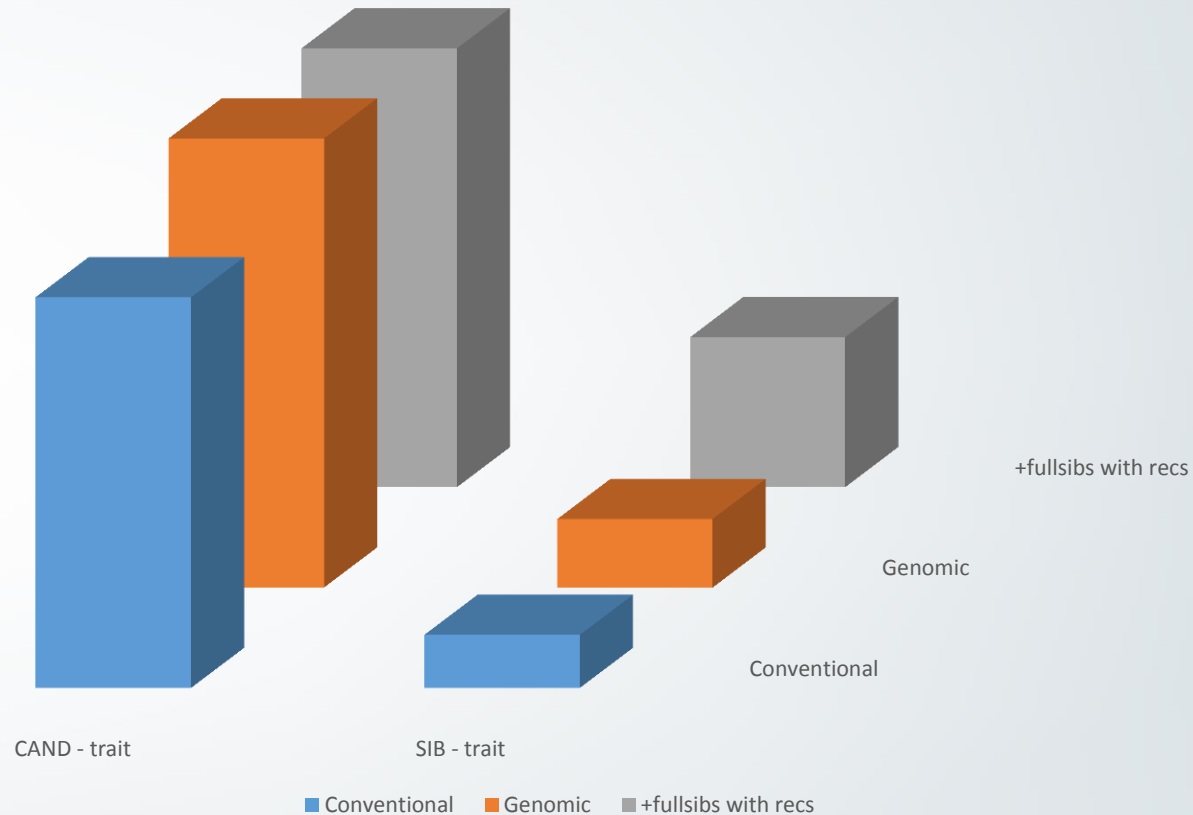
Conventional

■ Conventional

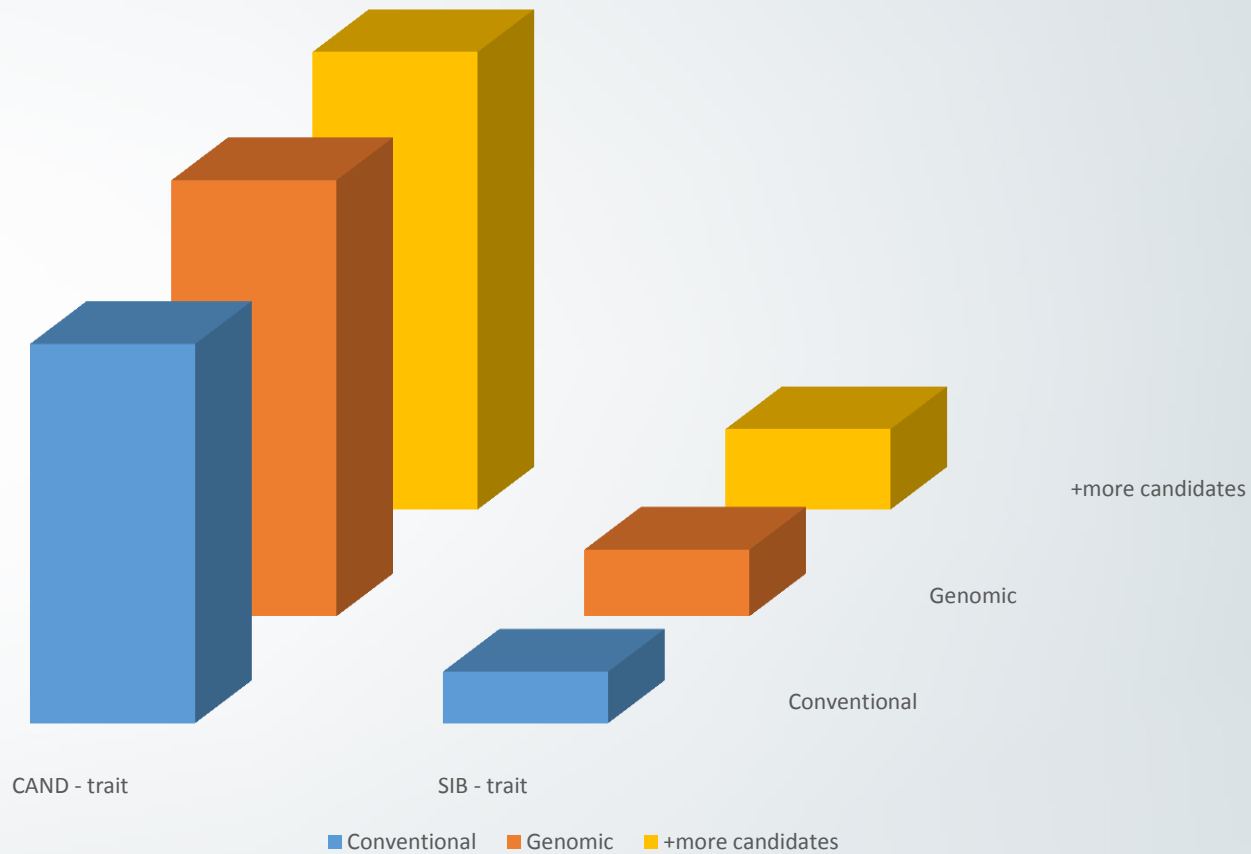
Selection for two traits: genetic gain



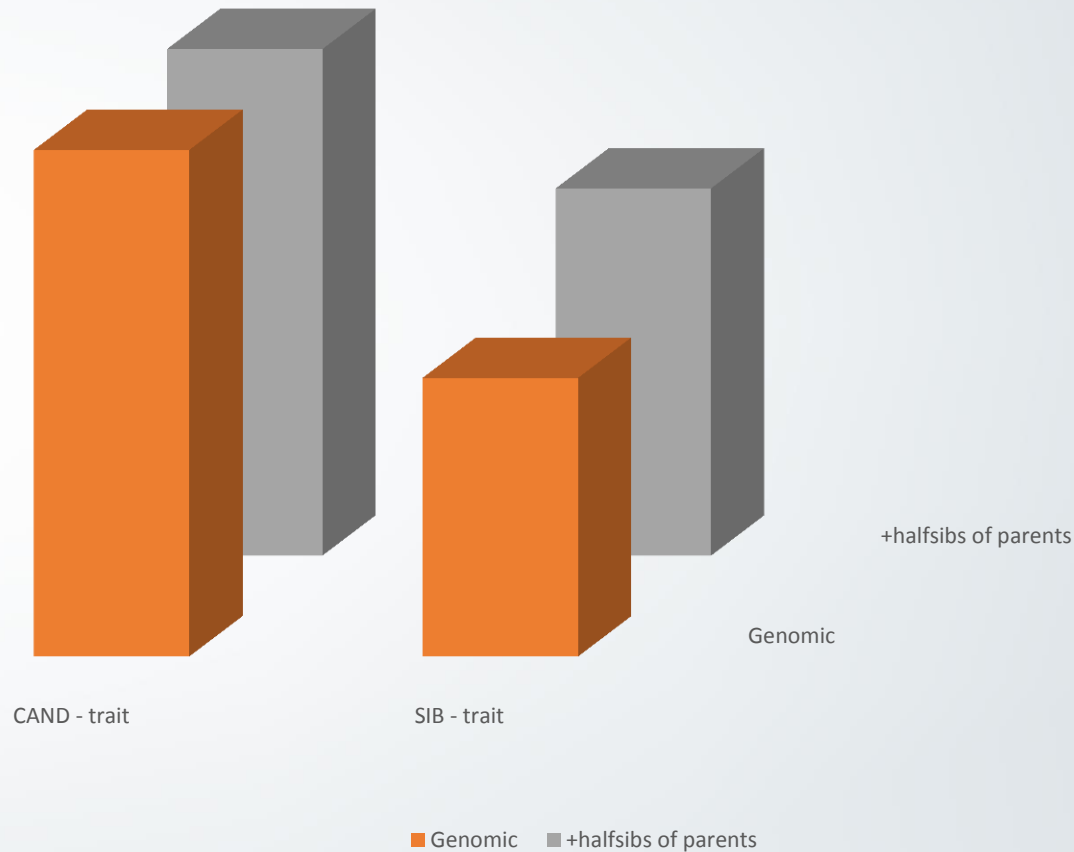
Selection for two traits: genetic gain



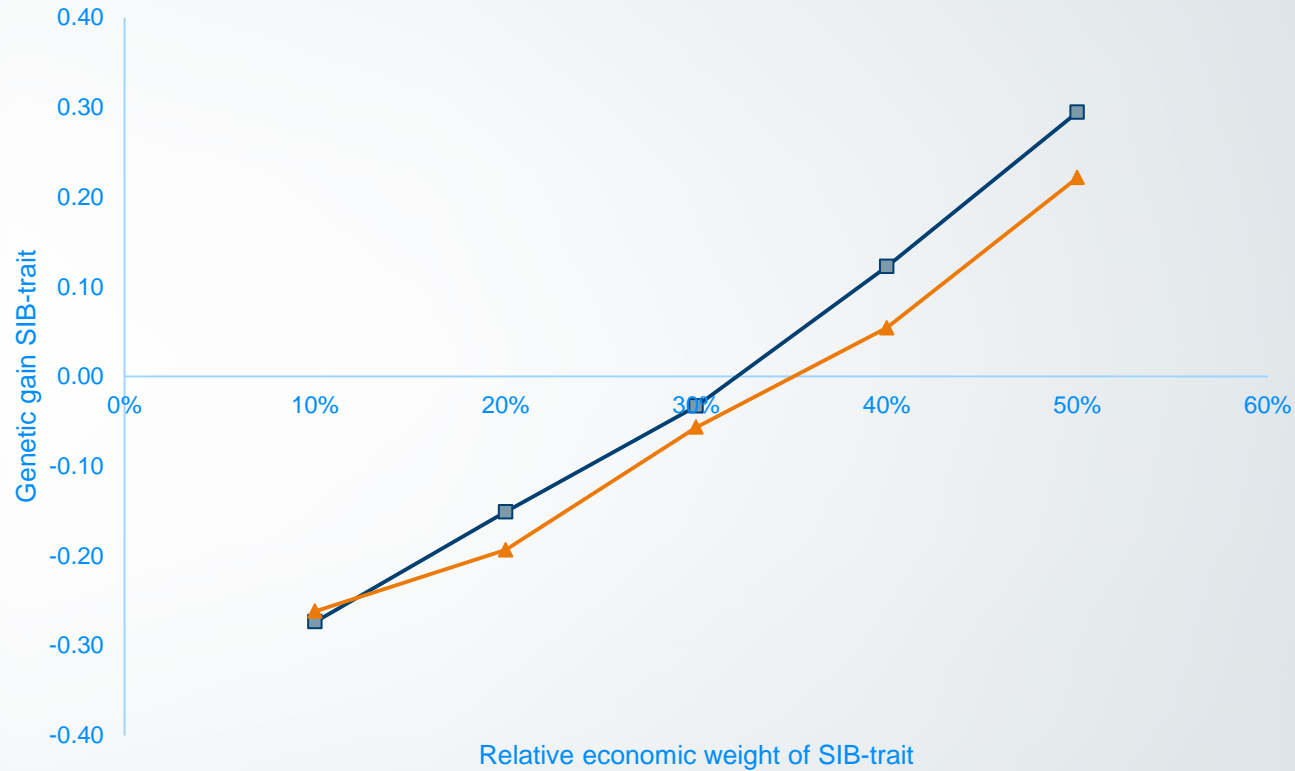
Selection for two traits: genetic gain

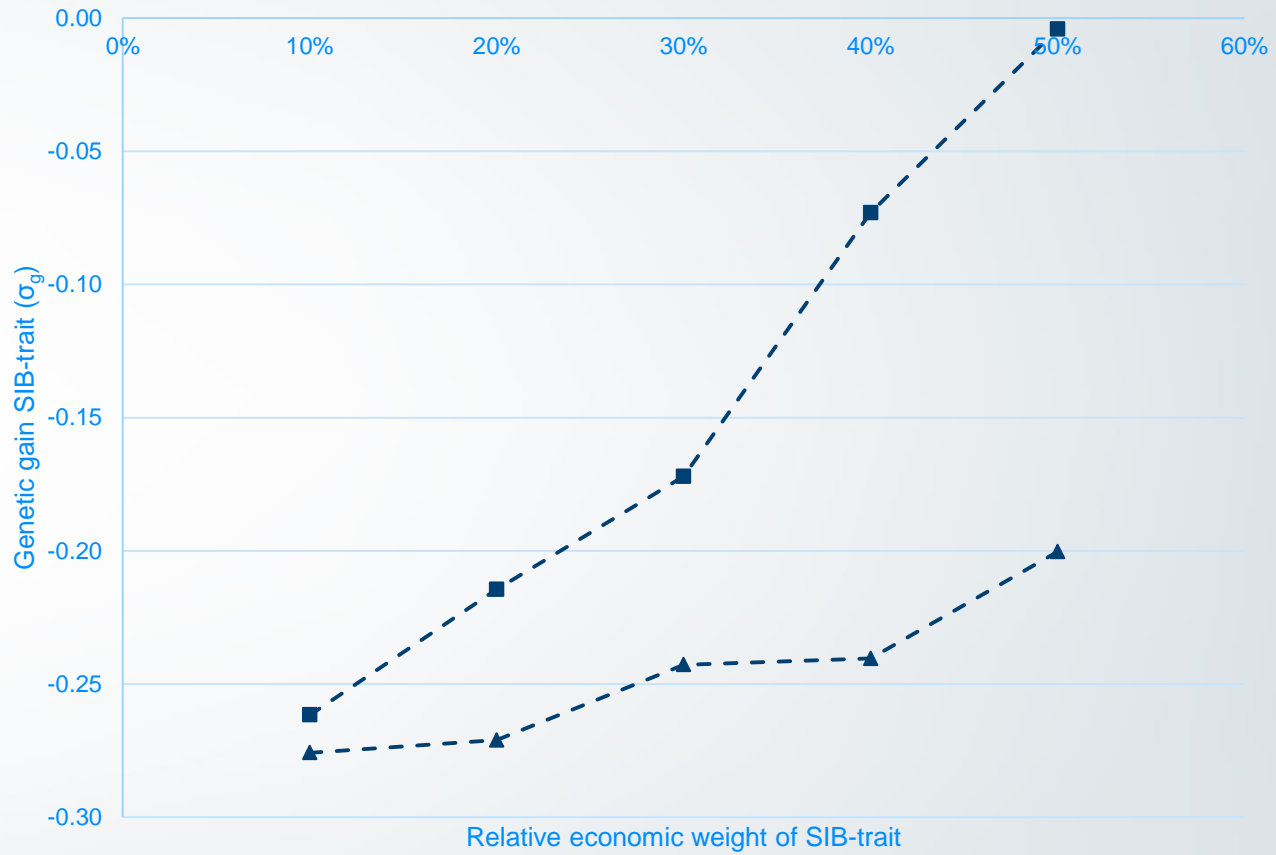


Selection for two traits: genetic gain



Effect of economic weight





Take home message:

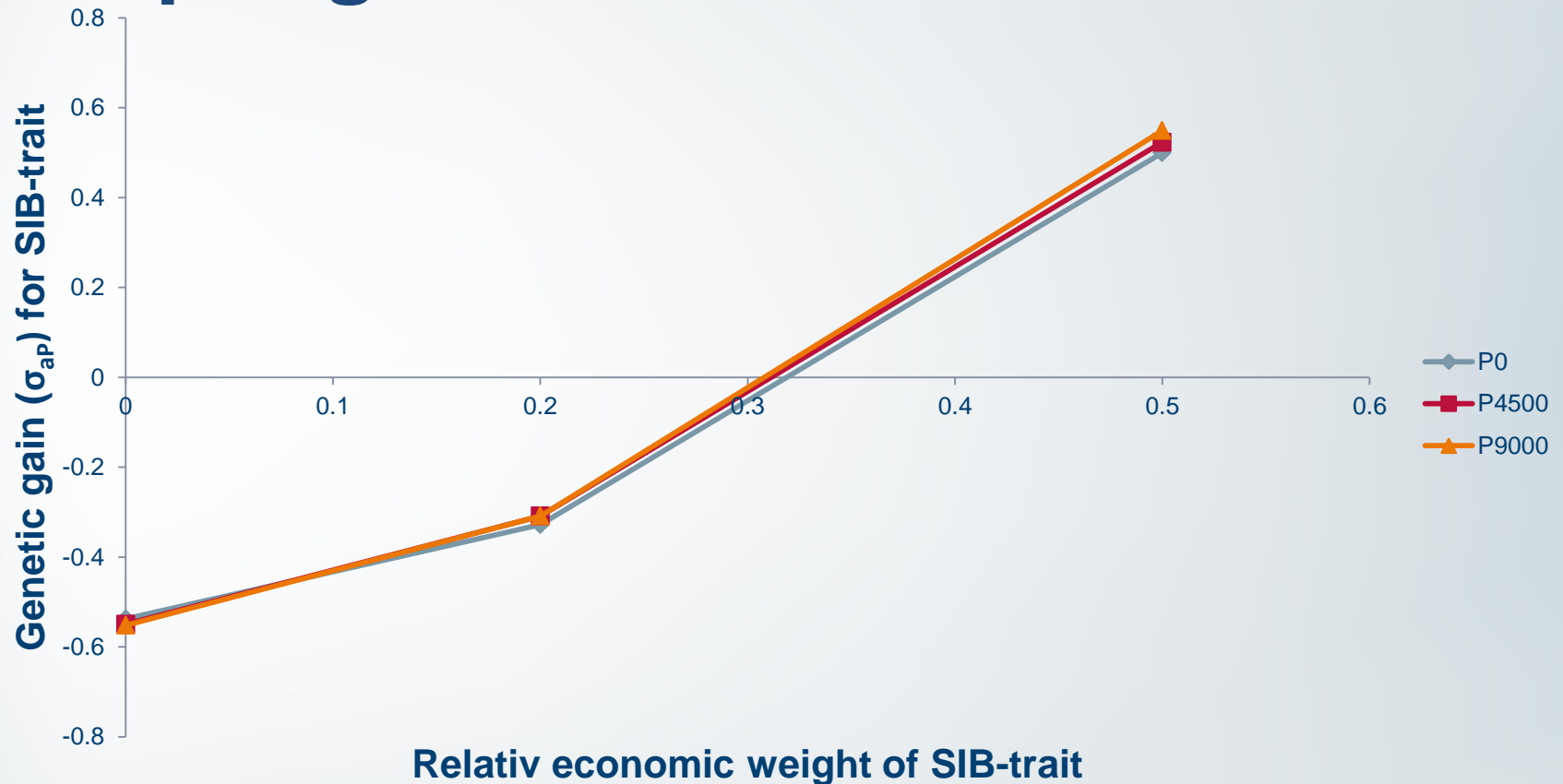
- All traits to be improved by genomic selection needs:
 - A considerable economic weight
 - Available data to update the reference population

Example 3: Salmon

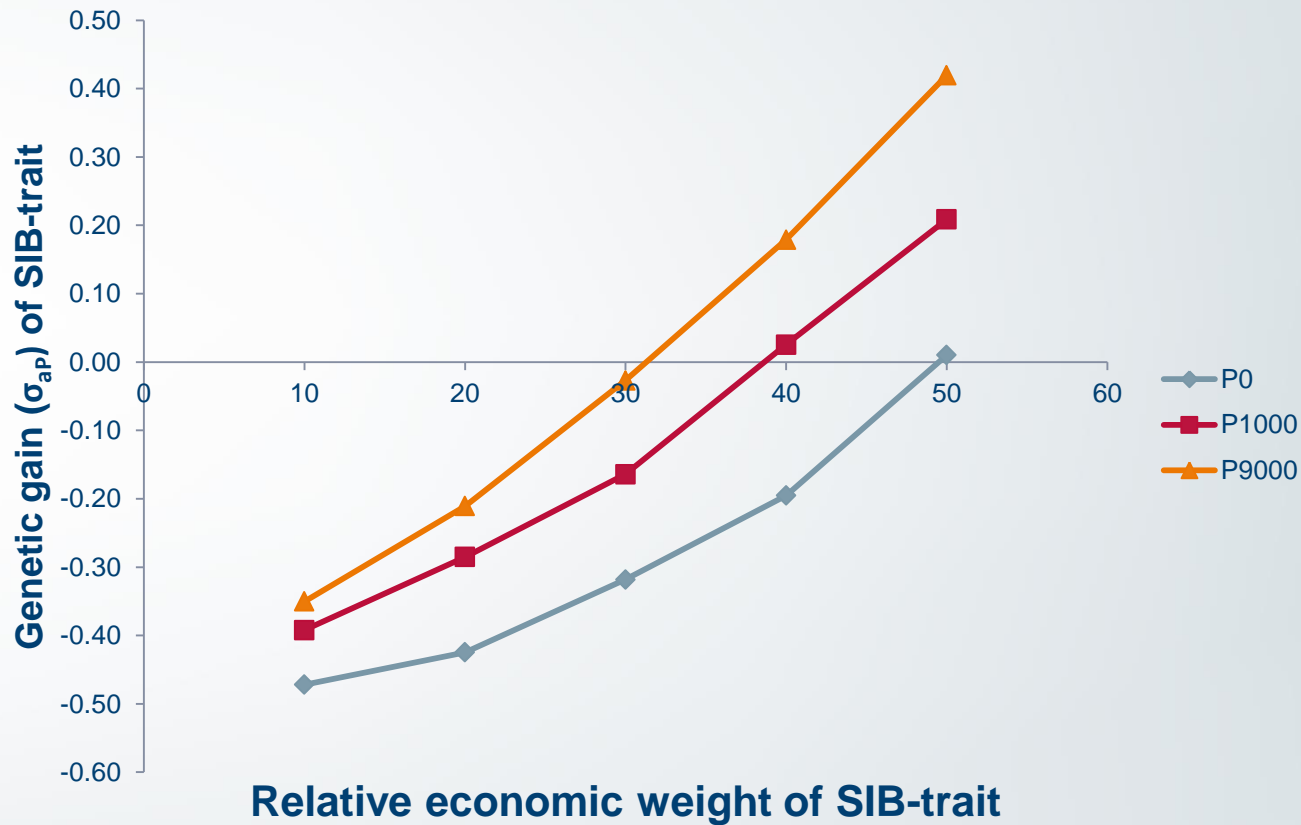
Challenge: Several traits measured on sibs of candidates. Different sibs for different traits.



Assuming nucleus males to get offspring with records



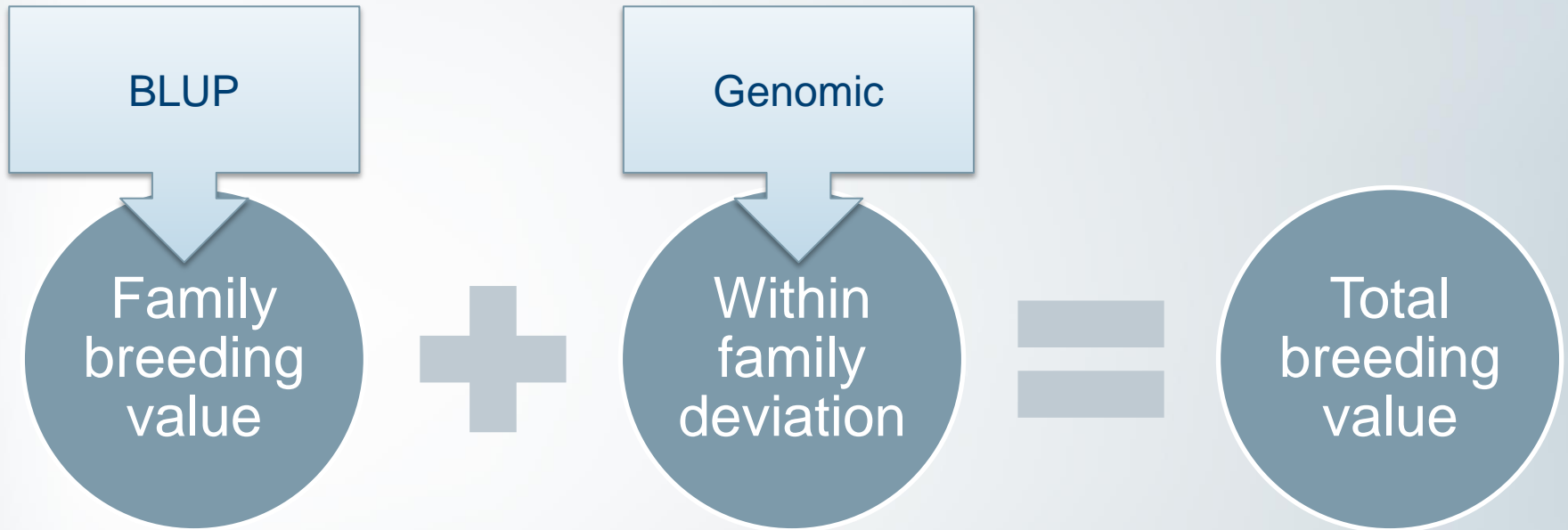
Assuming nucleus animals **NOT** to get offspring with records



How to reduce the costs of genotyping test-fish?

- «progeny test» of already genotyped nucleus animals (could be after selection)
- Pooled genotyping of test fish
- Low density genotyping
 - With imputation
 - Combined with pedigree information

Within family genomic selection



Take home message

- Evaluate the impact before running expensive genotyping

Conclusions

- The strategy to keep the reference population updated is an important part of the genomic selection breeding program
- Available options:
 - Genotyping of animals with phenotype
 - Obtain phenotypes from (offspring of) genotyped animals

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Takk for oppmerksomheten

www.nofima.no