

Increased genetic improvement by cooperation among breeding programs – example from breeding of English Setter in Sweden and Norway



Photo Maud Matsson

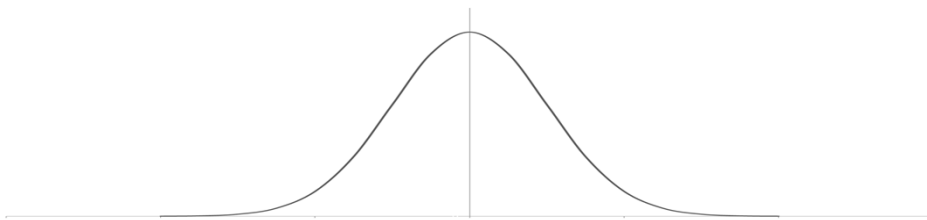
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Selection and genetic improvement



Selection and genetic improvement

Parent
generation

Dogs selected
for breeding

Phenotype

Offspring
generation



Genetic improvement

Phenotype

Selection and genetic improvement

Parent
generation

Dogs selected
for breeding

EBV

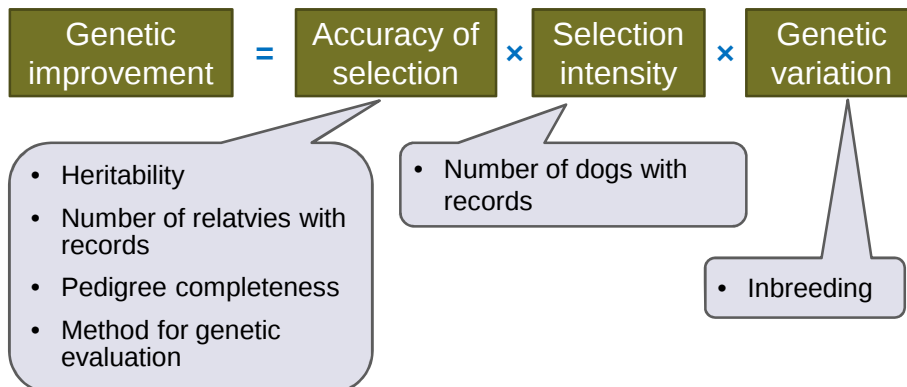
Offspring
generation



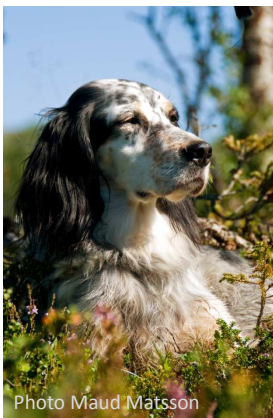
Genetic improvement

Phenotype

Factors affecting the genetic improvement per generation



Aim of the study



Is a joint Swedish-Norwegian genetic evaluation for English Setter hunting traits feasible?

- Genetic connections between populations?
- Can the pedigrees be merged?

If so, how big is the potential for increased rate of genetic improvement?

Setter Field Trials

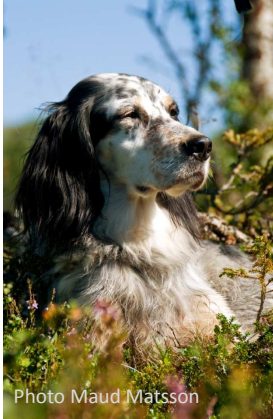


Photo Maud Matsson

- The English Setter is a pointing dog
- Hunting ability tested in field trials
- Similar trials in Sweden and Norway
- Six hunting traits rated in a hunting situation on equivalent six-step scales



Quartering (efficiency of search pattern)

Style (position of head and efficiency in gallop when searching)

Search width

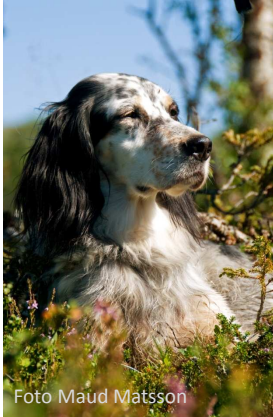
Speed (when searching)

Hunting drive (desire to find birds)

Cooperation (with handler in a hunting situation)

Maud Matsson

Differences between Sweden and Norway



- Five times as many English Setters registered annually in Norway
- Five times as many dogs assessed in Norway, and twice as many trials per dog
- 1-judge system in Sweden, 2-judge system in Norway
- More extensive education of Norwegian judges

Data

Parameters	Dogs assessed in Sweden (2003-2010)		Dogs assessed in Norway (1994-2011)	
	SKC pedigree	Joint pedigree	NKC pedigree	Joint pedigree
No. of records	3620		94 414	
No. of tested dogs	685		7175	
Complete Generation Eq. ¹	5.6		7.0	

¹ Boichard *et al.* 1997. Genetics, Selection, Evolution 29, 5-23.

Data

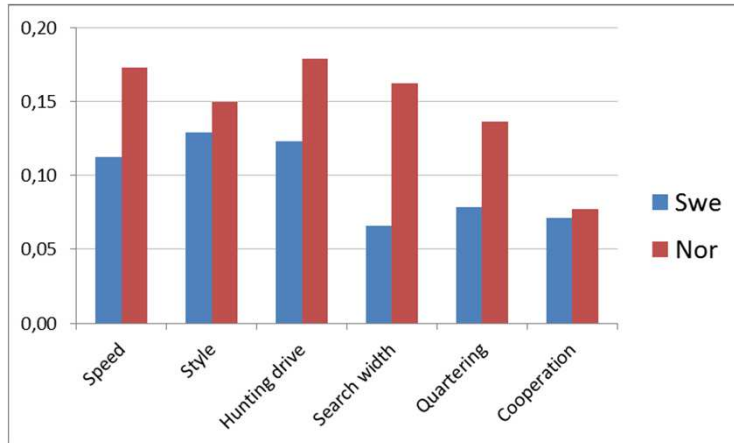
Parameters	Dogs assessed in Sweden (2003-2010)		Dogs assessed in Norway (1994-2011)	
	SKC pedigree	Joint pedigree	NKC pedigree	Joint pedigree
No. of records	3620	3736	94 414	94 520
No. of tested dogs	685	757	7175	7223
Complete Generation Eq. ¹	5.6	7.8	7.0	7.4

¹ Boichard *et al.* 1997. Genetics, Selection, Evolution 29, 5-23.

Genetic analyses

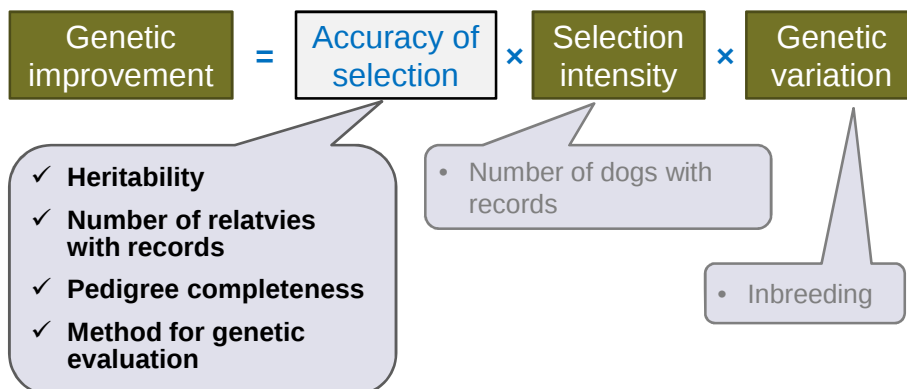
- 1) Based on national Norwegian and Swedish data:
Estimate heritabilities and accuracies of breeding values for all dogs and traits
- 2) Based on joint data:
Estimate heritabilities and accuracies of breeding values for all dogs and traits
- 3) Compare results within and between 1) and 2)

Heritabilities

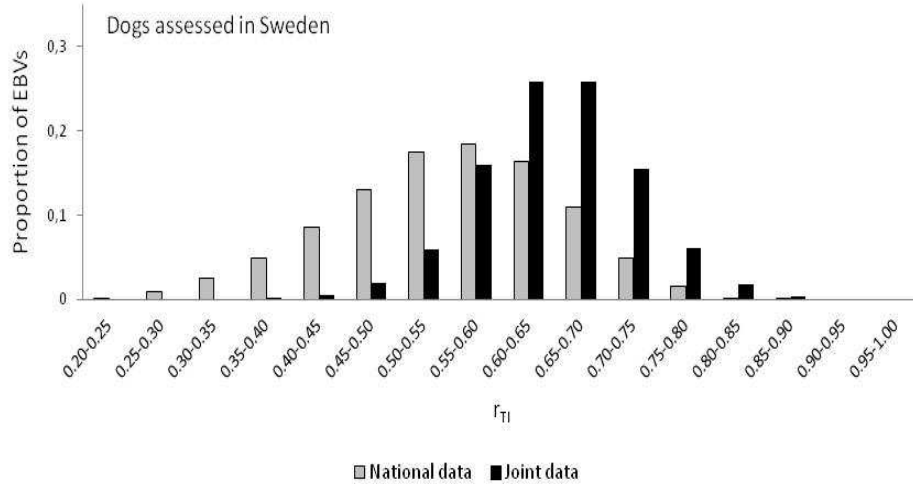


All heritabilities sign. different from zero ($p < 0.05$)

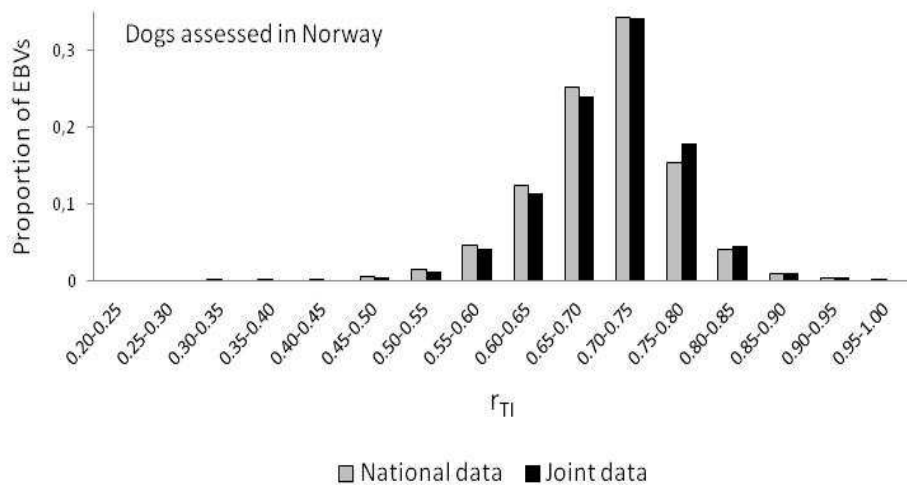
Factors affecting the genetic improvement per generation



Mean accuracy (r_{TI}) over 6 traits



Mean accuracy (r_{TI}) over 6 traits



Substantially increased genetic improvement in Sweden is possible

Mean accuracy for different selection methods

EBVs, national data:	0.55
EBVs, joint data:	0.65

Potential increase in genetic improvement

18%

Substantially increased genetic improvement in Sweden is possible

Mean accuracy for different selection methods

Phenotype alone:	0.33
EBVs, national data:	0.55
EBVs, joint data:	0.65

Potential increase in genetic improvement

66%

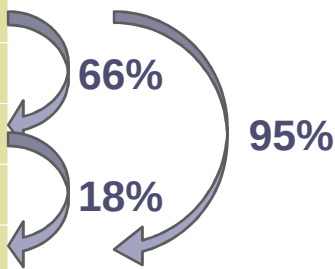
18%

Substantially increased genetic improvement in Sweden is possible

Mean accuracy for different selection methods

Phenotype alone:	0.33
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Potential increase in genetic improvement



Increased genetic improvement

Mean accuracy for different selection methods

Phenotype alone:	0.33
EBVs, national data:	0.55
EBVs, joint data:	0.65

Potential increase in genetic improvement



Increased number of selection candidates =>

selection intensity ↑,

inbreeding rate ↓

Genetic improvement

=

Accuracy of selection

×

Selection intensity

×

Genetic variation

Conclusion

Consider cooperation among breeding programs regarding genetic evaluation

- Make reliable recordings of relevant phenotypes
- Keep pedigrees in order

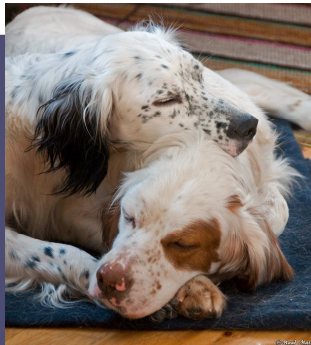
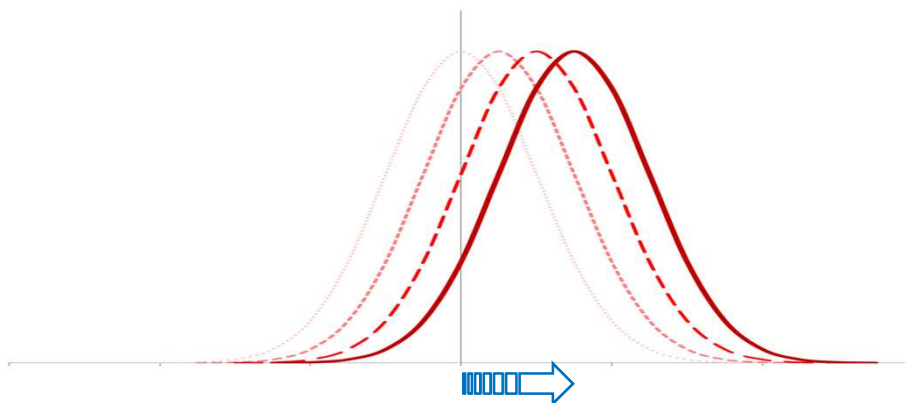
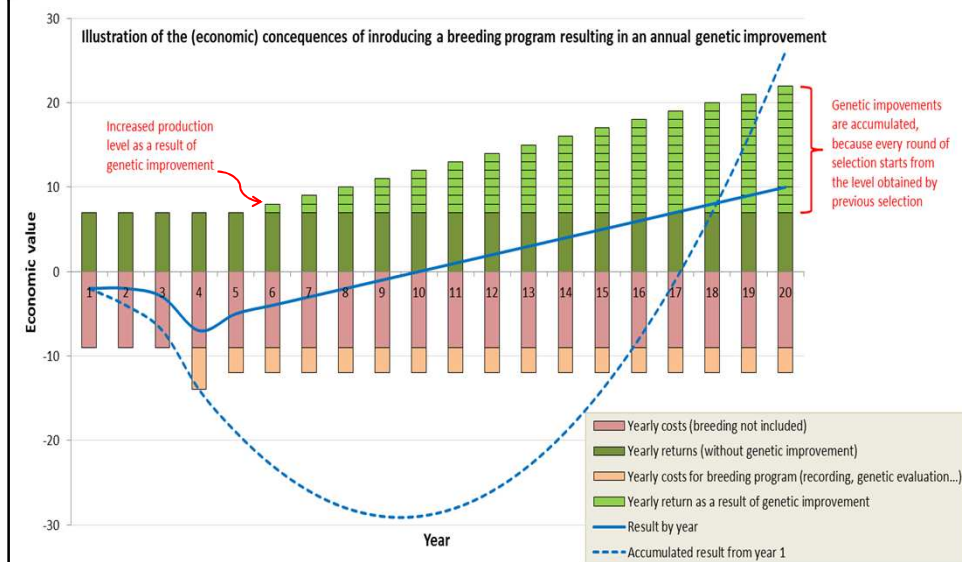


Photo Maud Matsson

Genetic improvements are accumulated over generations



Why invest in breeding?



Example score sheet differences

Trait	Score						
Country	1	2	3	4	5	6	
Speed							
Sweden	Not acceptable	Acceptable	Fairly good	Good	Very good	Excellent	
Norway	Very low speed	Low speed	Average speed	High speed	Very high speed	Particularly high speed	
Hunting drive							
Sweden	Not acceptable	Acceptable	Fairly good	Good	Very good	Excellent	
Norway	Very low intensity	Low intensity	Average intensity	Good intensity	Very good intensity	Particularly good intensity	

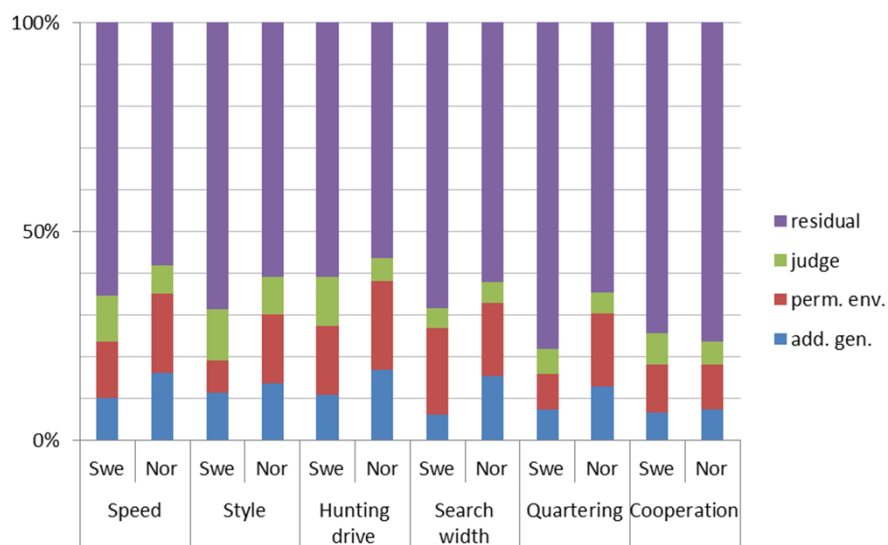
Genetic analyses

Model $y =$ Sex
 + Test year
 + Test month
 + Test type
 + Age at test $\times$ Test class
 + Genetic effect of the dog
 + Permanent environm. effect
 + Judge(s)
 + Residual

fixed

random

Relative influence of random effects



General differences between countries

Model $y = \text{Sex}$
 + Test year
 + Test month
 + Test type
 + Age at test $\times$ Test class
 + Genetic effect of the dog **Nor +**
 + Permanent environm. effect
 + Judge(s) **Swe +**
 + Residual **Swe +**

Correlations

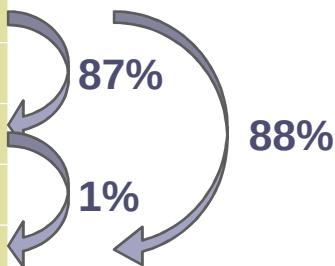
Trait combination	r_g	SE_g	r_{pe}	SE_{pe}	r_j	SE_j
Speed	0,80	0,14	0,80	0,11	0,10	0,23
Style	0,73	0,15	0,78	0,17	0,33	0,20
Hunting drive	0,95	0,12	0,73	0,10	0,10	0,23
Search width	0,91	0,11	(0,79)	NE	0,26	0,30
Quartering	0,83	0,11	(0,85)	NE	0,94	0,15
Cooperation	0,87	0,16	0,83	0,14	0,40	0,24

...and so it is in Norway

Mean accuracy for different selection methods

Phenotype alone:	0.38
EBVs, national data:	0.70
EBVs, joint data:	0.71

Potential increase in genetic improvement



Increased genetic improvement

Select breeding animals based on EBVs (**accuracy**↑)

Cooperation among breeding programs advantageous, especially - but not only(!) - for the population with limited information

- More complete pedigree and more dogs with records (**accuracy**↑)
- Increased number of selection candidates (**selection intensity**↑, **inbreeding rate**↓)