Nordic Cattle Genetic Evaluation a tool for practical breeding with red breeds

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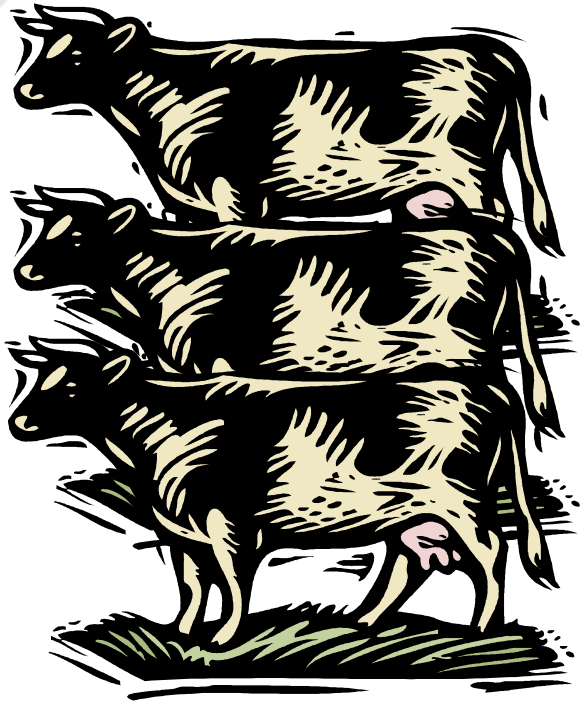
Nordic Cattle Genetic Evaluation (NCGE) a tool for practical breeding with red breeds

1. Introduction
2. Breeding structure
3. Data collection
4. Genetic evaluation
5. Publication of EBVs
6. Breeding goal
7. Future plans
8. Final remarks and conclusion

Nordic Cattle Genetic Evaluation



NAV

NAV

Established 01.01.2002 by:

Faba breeding

Swedish Dairy Association

Danish Cattle

Nordic Cattle Genetic Evaluation - history

- 2002 - Established
- 2002 – Development has started
- 2005 – first EBVs published – type, milk ability, temperament and fertility
- 2006 – Yield and mastitis

NAVs board

- Finland
  - Jaana Kiljunen
  - Anna Lappalinen
- Sweden
  - Lennart Andersson
  - Lars-Inge Gunnarsson (chairman)
- Denmark
  - Henrik Nygaard
  - Jan Duchwaider (vice chairman)

NAV – Goal

- To use international accepted methods for estimation of BVs
- To focus on development of methods within the “Nordic traits” – mastitis, fertility etc.
- To improve the breeding work using new registrations

NAV – Goal

- To give the practical cattle breeding the best selection tool to achieve maximal genetic progress

or with other words

- How do we get the best possible methods for estimation of BVs within our Nordic Total Merit index in use in practice

Perspectives - Joint Nordic estimation of breeding values

- Simultaneously use of all data and relationships between Nordic animals
- All cows and sires can be directly compared

Perspectives – joint Nordic Estimation of breeding values

- Use resources more efficient:
  - Development of new method
  - Routine evaluation
- Joint platform for practical breeding work

EBVs can be compared across the Nordic countries

Nordic

1	Cow 9	Finland
2	Cow 5	Sweden
3	Cow 1	Denmark
4	Cow 2	Denmark
5	Cow 6	Sweden

Sweden
141.000 SRB
158.000 HF

Finland
165.000 FAY
71.000 HF

Denmark
42.000 RDM
372.000 HF
60.000 Jersey

Herd size, number of cows

	2006	2000
Denmark	113	73
Finland	24	18
Sweden	48	34

Number of herds

	2006	2000
Denmark	4500	7600
Finland	10100	15200
Sweden	6500	9100

Average yield, all breeds

		Milk	Fat	Protein
Denmark	2000	7610	327	264
	2006	**8778**	**378**	**301**
Finland	2000	7775	332	264
	2006	**8639**	**361**	**297**
Sweden	2000	8537	351	286
	2006	**9107**	**376**	**310**

Average yield, RDC, 2006

	Milk	Fat, kg	Protein, kg
Denmark	8560	364	300
Finland	8472	363	293
Sweden	8633	373	301

Average yield, RDC, 2006

	Milk	Fat, kg	Protein, kg
Denmark	8560	364	300
	(9232)	(380)	(309)
Finland	8472	363	293
	(9122)	(358)	(309)
Sweden	8633	373	301
	(9645)	(386)	(322)

Average yield, RDC 2006

	Fat %	Protein %
Denmark	4.25	3.50
Finland	4.29	3.46
Sweden	4.32	3.39

Average yield RDC, 2006

	Fat %	Protein %
Denmark	4.25 (4.12)	3.50 (3.35)
Finland	4,29 (3.93)	3,46 (3.39)
Sweden	4.32 (4.00)	3.39 (3.34)

Breed characteristics RDC compared to Holstein

- Yield traits
  - 700-900 kg milk; 5-15 kg fat, 10-20 kg protein (RDC less)
- Stature
  - 4-6 cm (RDC lowest)
- Mastitis
  - 2-3% (RDC less mastitis)
- Fertility
  - Calving interval 15 days (RDC shortest)
- Live born calves
  - 3-5% (RDC less still born)

Total Merit – RDC compared to Holstein

M. Lidfeldt (2006):

SRB and Swedish Holstein

same level – Total Merit

Tested young bulls

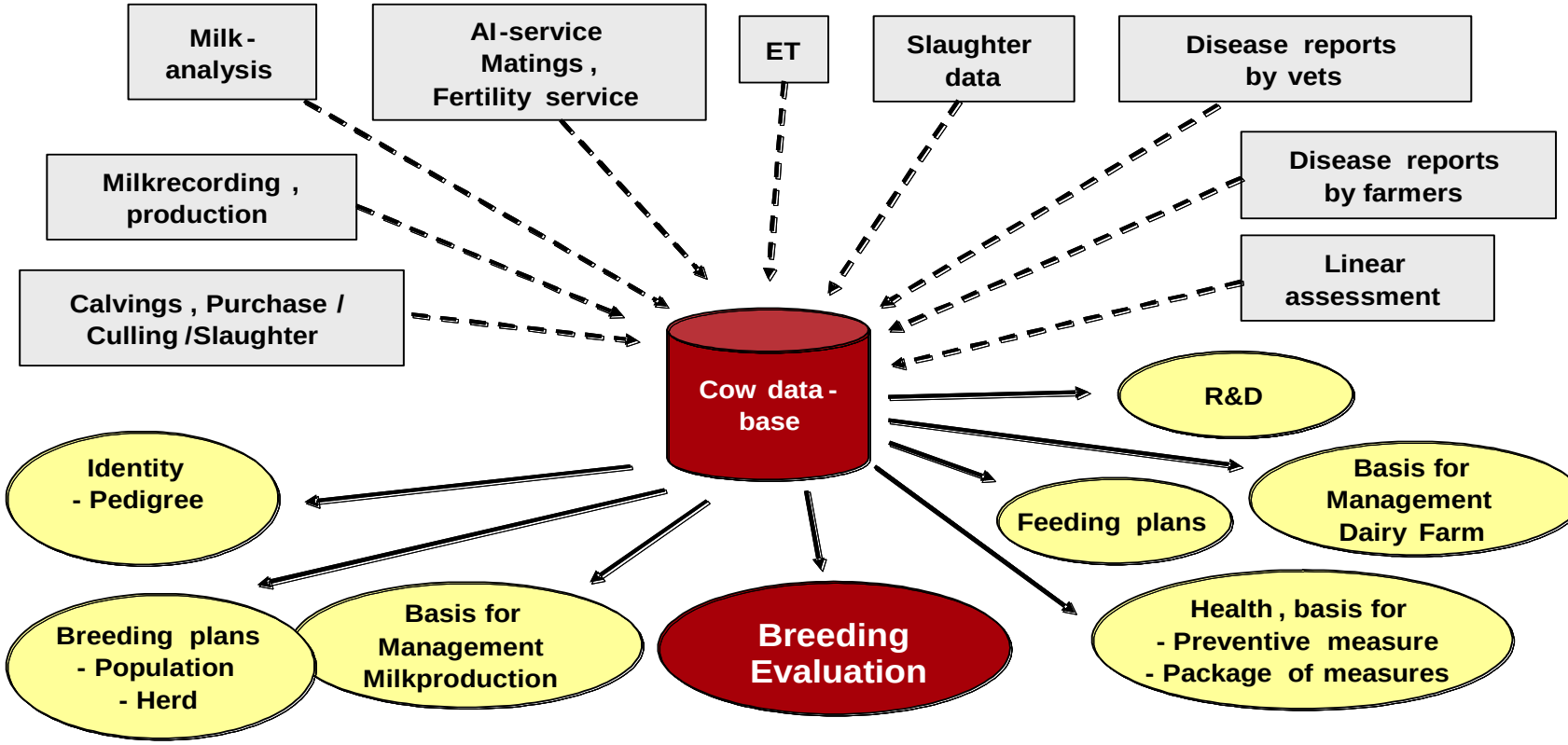
- 270 RDC bulls
- 370 Holstein
- 60 Jersey

- 30% of the females inseminated by young bulls
- Progeny group size 90-250 (smallest DNK largest FIN)

Harmonization of registration

Denmark, Finland and Sweden have nearly 100% similarity in registration

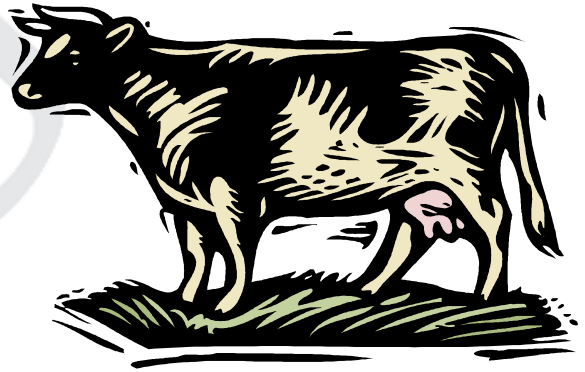
Cow database



Data flow in relation to the central data base

Registration

- Pedigree:
  - Complete pedigree (unique id)
- Traits:
  - Production
  - SCC
  - Type traits, milking speed and temperament
  - Longevity
  - Fertility traits
  - Calving traits
  - Disease treatments - mastitis



Harmonization of registration

- Ongoing harmonization work:
  - Type traits
    - Exactly the same traits are scored (Finland 4 new, Denmark 1 new)
    - Joint manual
    - Nordic classifier workshop every 2nd year
  - Hoof trimming data, other future reg.

Mammary system- 2004

	SWE	DNK	FIN
Fore udder	X	X	X
Rear udder heigth	X	X	X
Rear udder width	X	X	X
Udder support	X	X	X
Udder depth	X	X	X
Teat length	X	X	X
Teat thickness	(X)	X	
Teat place. (front)	X	X	X
Teat place. (back)	(X)	X	X
Udder balance	X		X

Mammary system - 2007

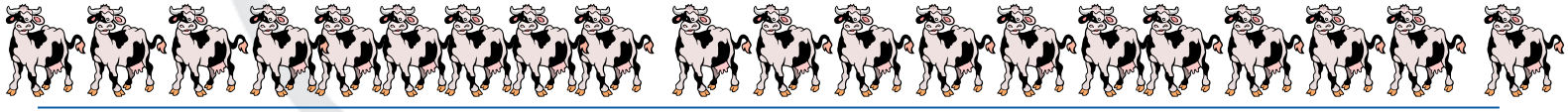
	SWE	DNK	FIN
Fore udder	X	X	X
Rear udder heigth	X	X	X
Rear udder width	X	X	X
Udder support	X	X	X
Udder depth	X	X	X
Teat length	X	X	X
Teat thickness	X	X	x
Teat place. (front)	X	X	X
Teat place. (back)	X	X	X
Udder balance	X	X	X

Data registration and quality

- Coming years:
  - Functional traits will be recorded on large scale outside the Nordic countries
  - Data quality need attention
  - Focus on easy and accurate registration – also a challenge for Nordic countries
  - New traits

Progeny testing – correct sire

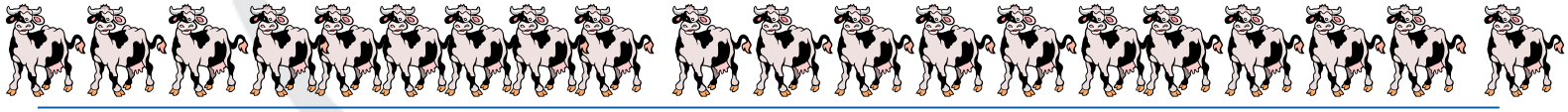
Bull A



Bull B

Progeny testing – correct recording

Bull A

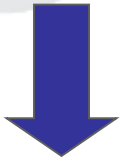


Bull B

Progeny testing

- Error in registration of pedigree or phenotype

- Less reliable EBVs



- Less accurate selection of breeding animals

- Less genetic progress

Estimation of breeding values

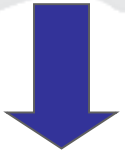
Use the registered data in the best possible way

Estimate accurate EBVs

- **Improved statistical models**
- **New traits**

Estimation of breeding values

- Improved statistical models



- More accurate EBVs

- More accurate selection of breeding animals

- Higher genetic progress

Genetic evaluation

Finland, Sweden and Denmark benefits from their similar registration systems in the Joint Nordic Genetic Evaluation

Same traits measured in all countries

Practical advantage

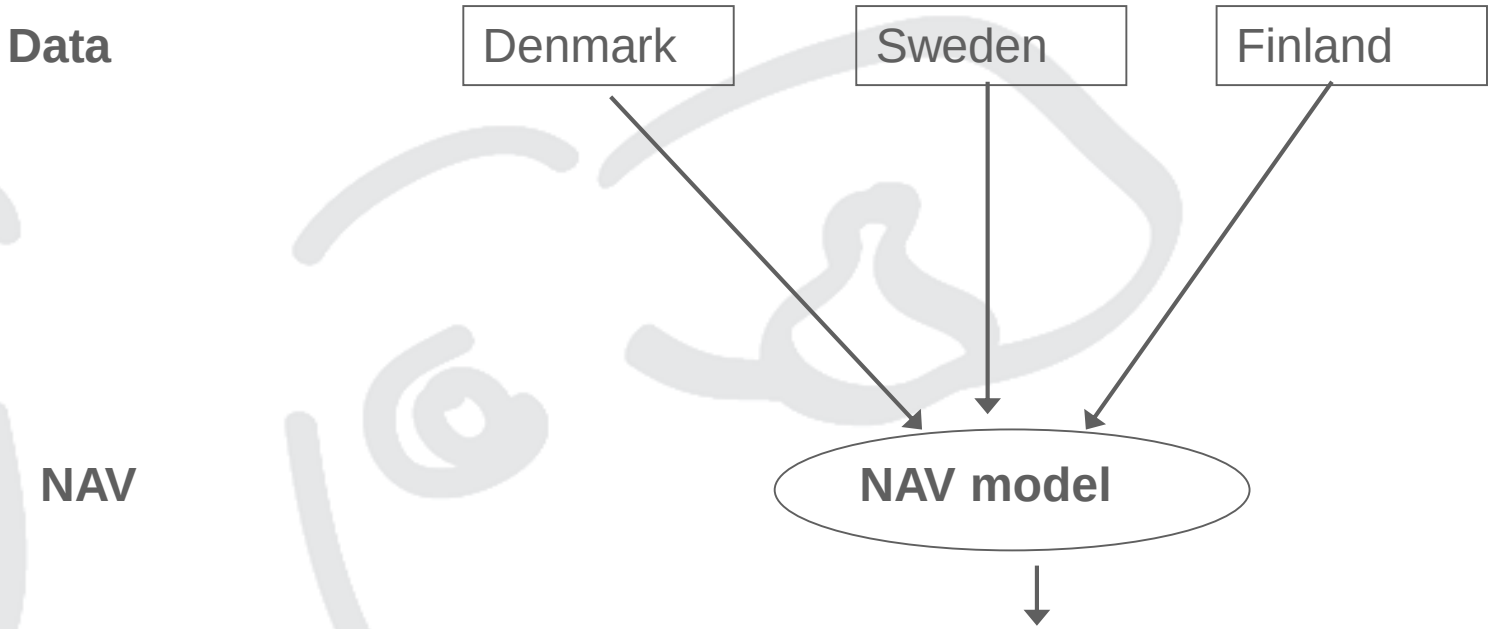
- **One BV per animal**

Theoretical reasonable assumption

- **INTERBULL-correlations high**
- **G x E studies no significant effects**
- **No effect within country even though we have 20 years with a significant increase in production**

All models are validated with statistical tests

Genetic evaluation



NAV- EBVs

Joint ranking of animals

- **Expressed on rolling ”cow base” – mean 100**
- **Expressed with a standard deviation of 10**

Nordic Cattle Genetic Evaluation – routine evaluation

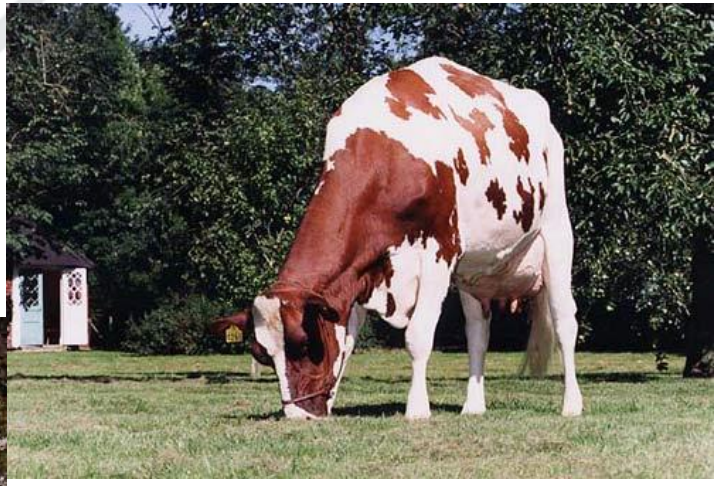
- 2005 – First EBVs joint EBVs published – type, milk ability, temperament and fertility
- 2006 – Yield and mastitis

Nordic Cattle Genetic Evaluation – ongoing development work

- Calving traits
- Update of yield model
- Other diseases
- Total Merit index

Peterslund, SRB

Peterslund daughters milking in Sweden, Finland or Denmark



From national to Nordic - SRB-bull Peterslund

National ***Nordic***

Danish EBVs ← **47 daughters** →

Finish EBVs ← **2,674 daughters** →

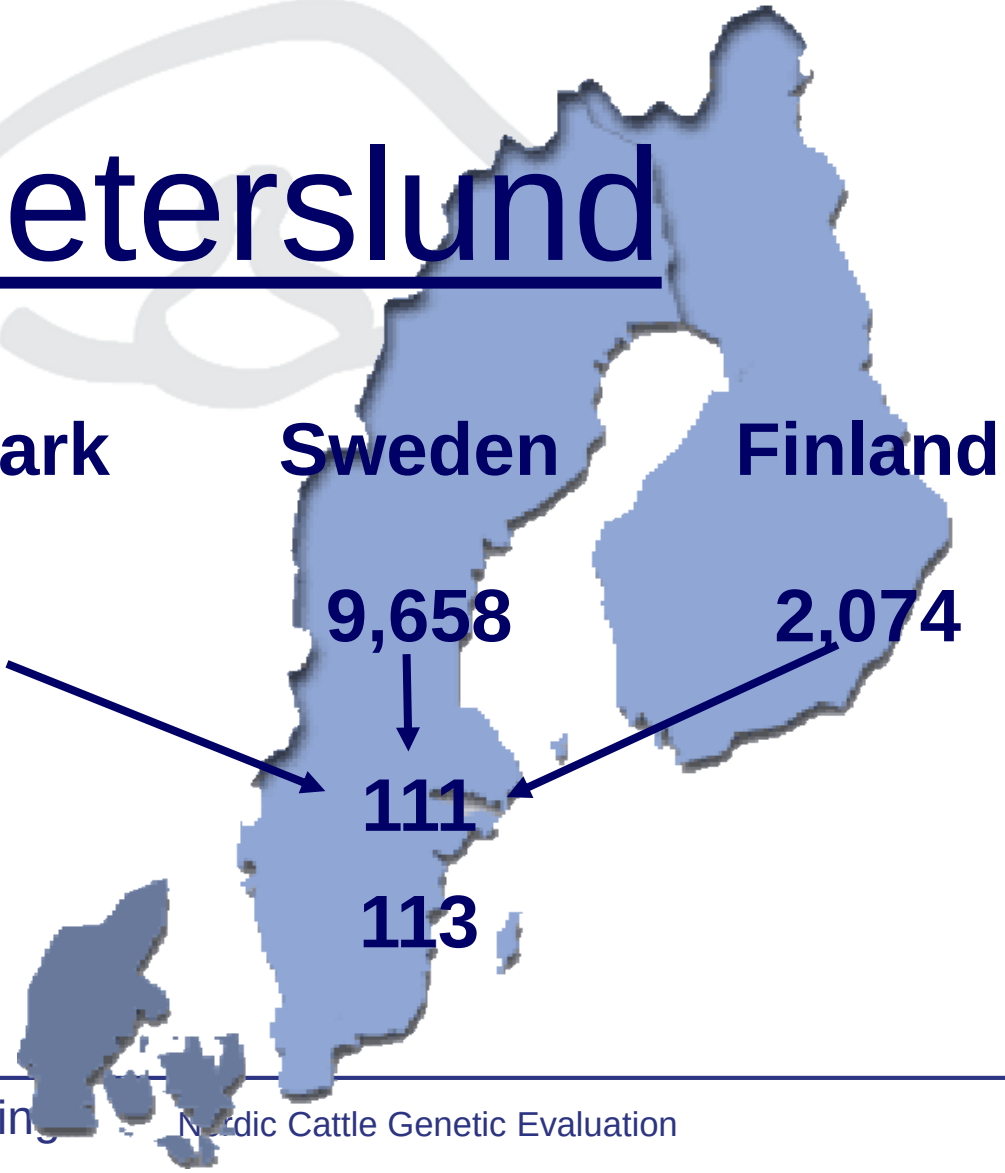
Swedish EBVs ← **9,658 daughters** →

Nordic EBVs
12,379 daughters

Breeding values can be compared across Denmark, Finland and Sweden

Peterslund

	Denmark	Sweden	Finland
Number of daughters	47	9,658	2,074
Yield index		111	
Udder health		113	



NAV

Peterslund – July 2007

Danish, Finnish and Swedish EBVs can be compared directly for:

- **Yield**
- **Mastitis**
- **Fertility traits**
- **Type traits**
- **Temperament and milk ability**

Routine genetic evaluation

- 3 breed groups – RDC, Holstein and Jersey

- Frequency:
- Today: 7 times a year: yield and type and 4 times a year all other traits
- 2008 onwards: 6 times per year all traits

EBV - yield

- **Multi trait multi lactation TD model**
  - **TD data from Finland and Denmark, 305 Day data from Sweden**
  - **1,2 and 3 lactation**
  - **Milk, fat and protein**

EBV – udder health - Nordic

Definition of mastitis traits:

- **15 days before calving until 50 days after calving in 1st parity**
- **51 days after calving until 300 days after calving in 1st parity**
- **15 days before calving until 150 days after calving in second parity**
- **15 days before calving until 150 days after calving in third parity**

EBV – udder health - Nordic

Information traits:

- **SCC day 5-150 after calving in 1st parity**
- **SCC day 5-150 after calving in 2nd parity**
- **SCC day 5-150 after calving in 3rd parity**
- **Udder depth 1st parity**
- **Fore udder attach. 1st parity**

EBV – udder health
Genetic parameters

- **Clinical mastitis** 4%
  - SCC 13%
  - Udder conformation 25%

- **Genetic correlations:**
  - CM different lactations 0.70-0.95
  - CM-SCC 0.60
  - CM-Udder conformation 0.35-0.50

EBV–udder health - Reliability (r_{IA}^2)

- Udder health in theory
  - Based on CM - max 100%
  - Based on SCC – max 36% (r_g^2)
- Udder health in practice (DNK)
  - 40% first proof same time as production
  - 60-65% based on 1. lact. daughters
- FIN and SWE higher r_{IA}^2 due to larger daughter group size!

Fertility index

	Information	Economic weight in fertility index
1st ins-last ins heifers	X	X
Number of ins heifers	X	X
Calv.-1st ins cows	X	X
1st ins -last ins cows	X	X
Number of ins cows	X	X
Fertility treatment cows	X	X
Heat strength cows	X	

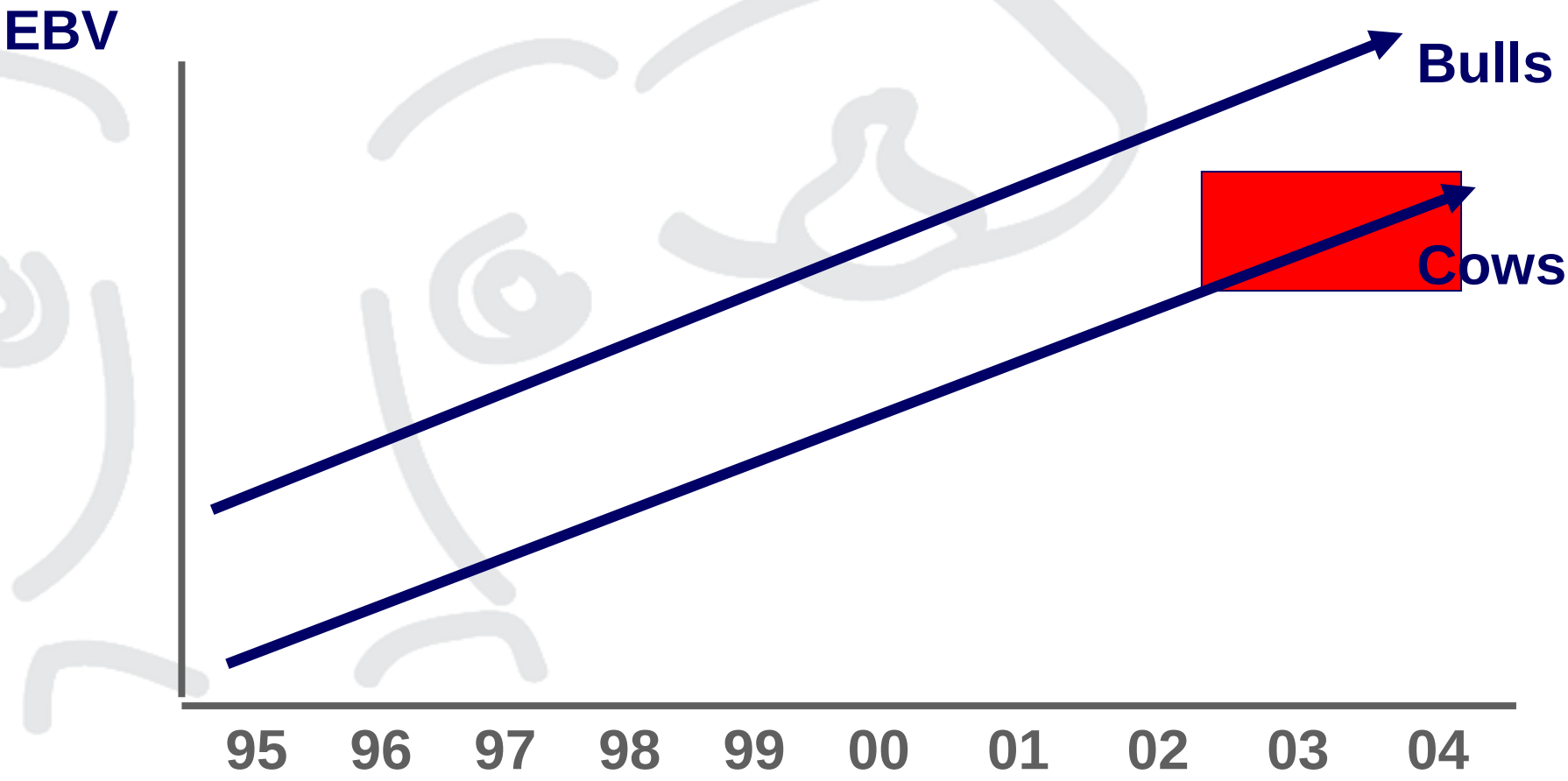
Nordic routine evaluation

- **Presentation of breeding values**
  - **Common base**
  - **Common standard deviation**
- **Number of routine runs per year**
  - **Dates for publishing EBVs**
- **Breeders in Denmark, Finland and Sweden can see the same EBVs at the same time**

Nordic presentation of EBVs

- **Common base**
  - **Cow base – 2 birth years (1.6.2002-1.6.2004)**
  - **Average 100 all traits**
  - **Same base for cows/heifers and sires**
  - **Base update at each routine run**

Nordic - genetic base



Standard deviation

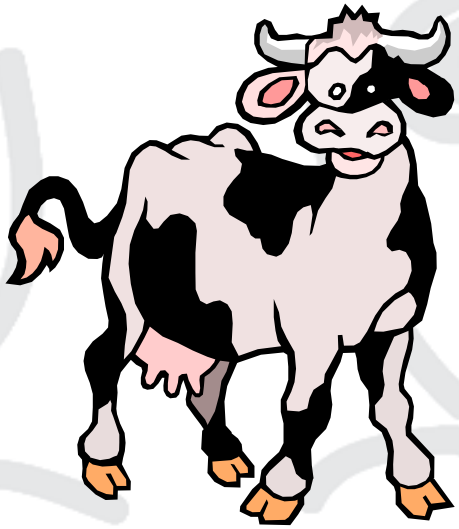
- **Express the variation around a mean**
- **Standard deviation 10**
  - **67% of the sires has EBVs between 90 and 110 for traits with out genetic changes over years**
  - Standardizations factors for all traits based on bulls born in 1997-98 with a Nordic 1st batch of daughters

Presentation of EBVs

	Until 15 April 2005		Today	
	Base	Standard deviation	Base	Standard deviation
Sweden	100	7		
Finland	100	10	100	10
Denmark	100	5		
Denmark type	0	1		

Breeding goal

Get maximum economic gain



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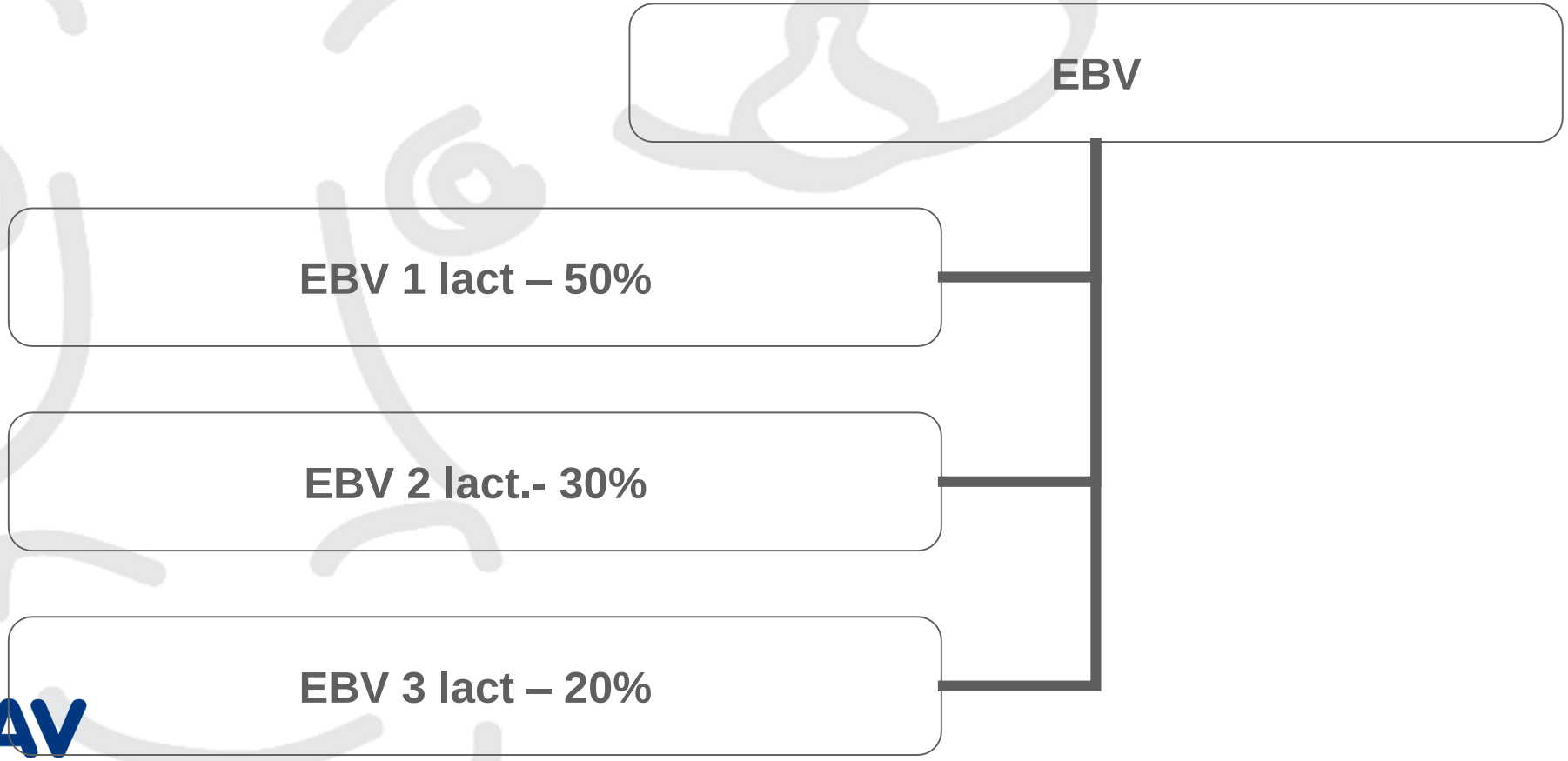
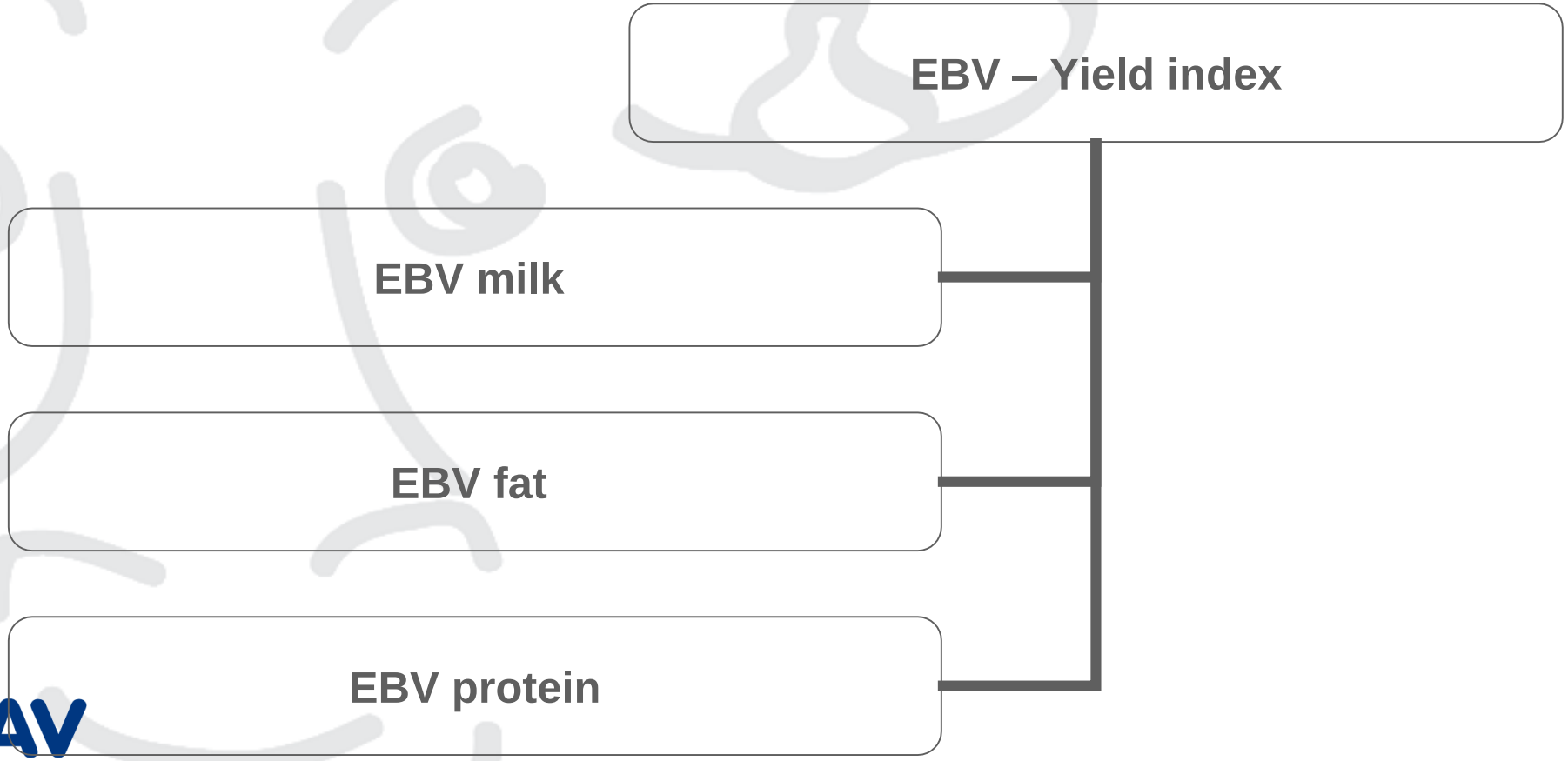
Sub index – across lactation
e.g. Protein



Sub index – across traits within same group of traits e.g. Yield

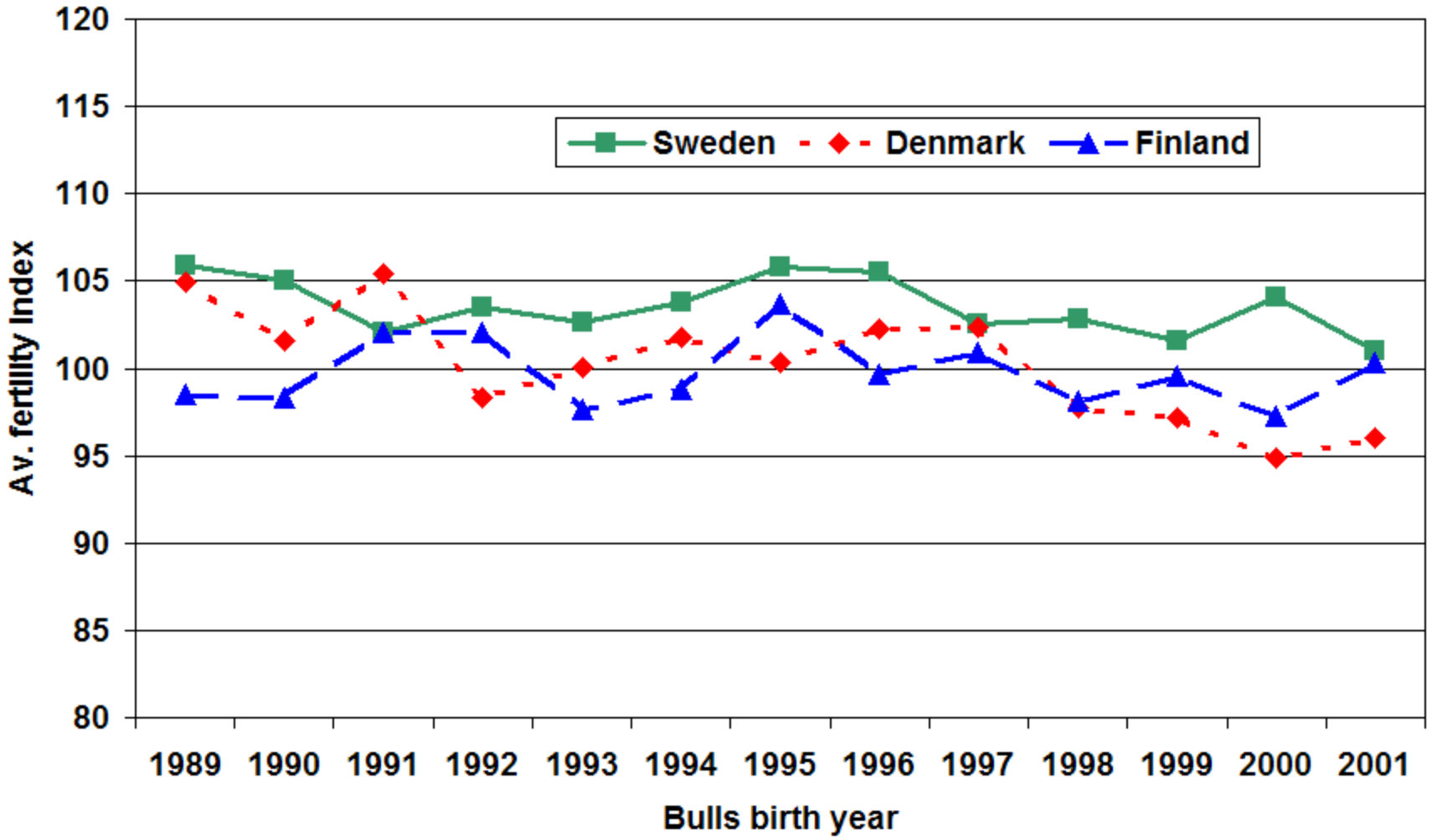


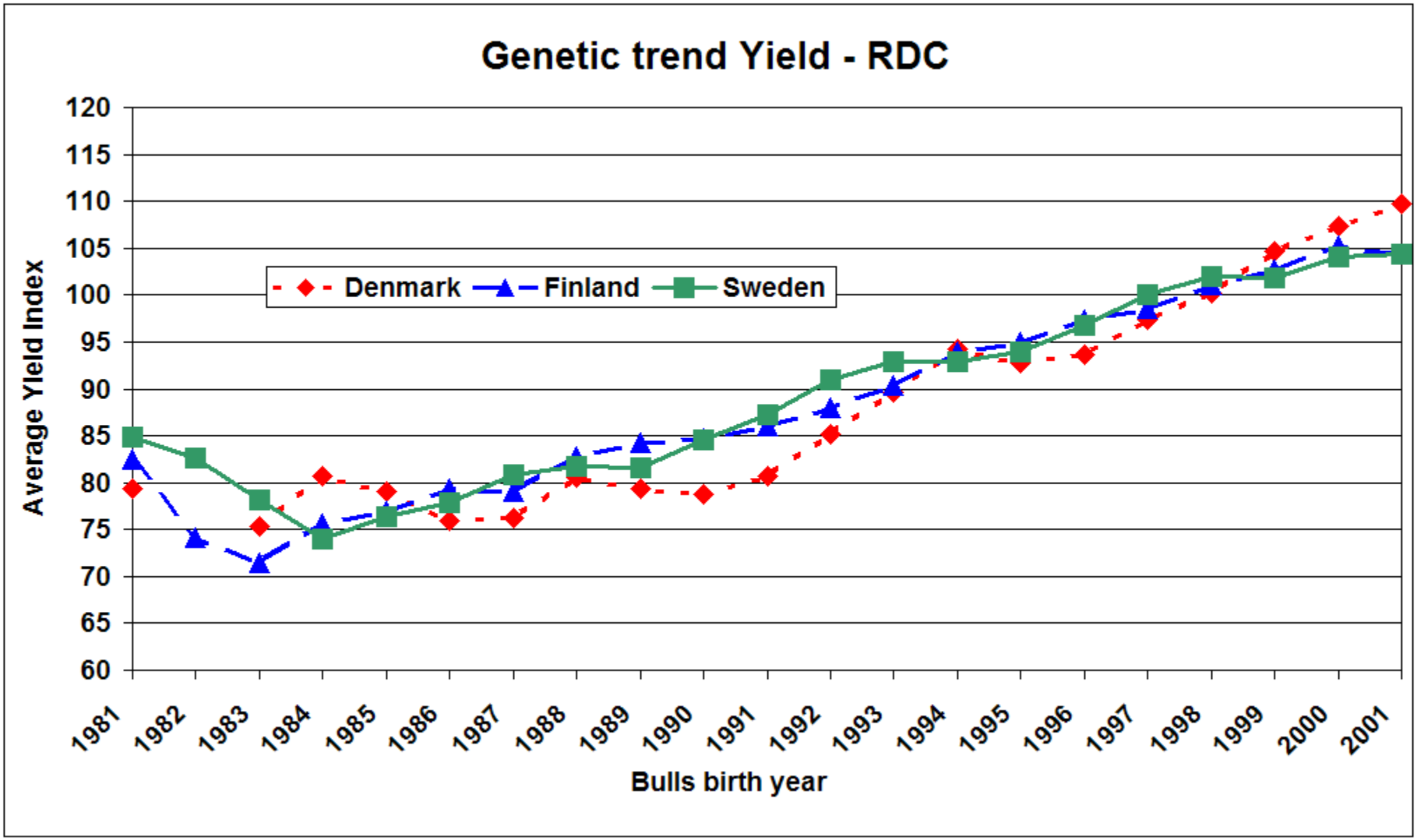
Joint sub index

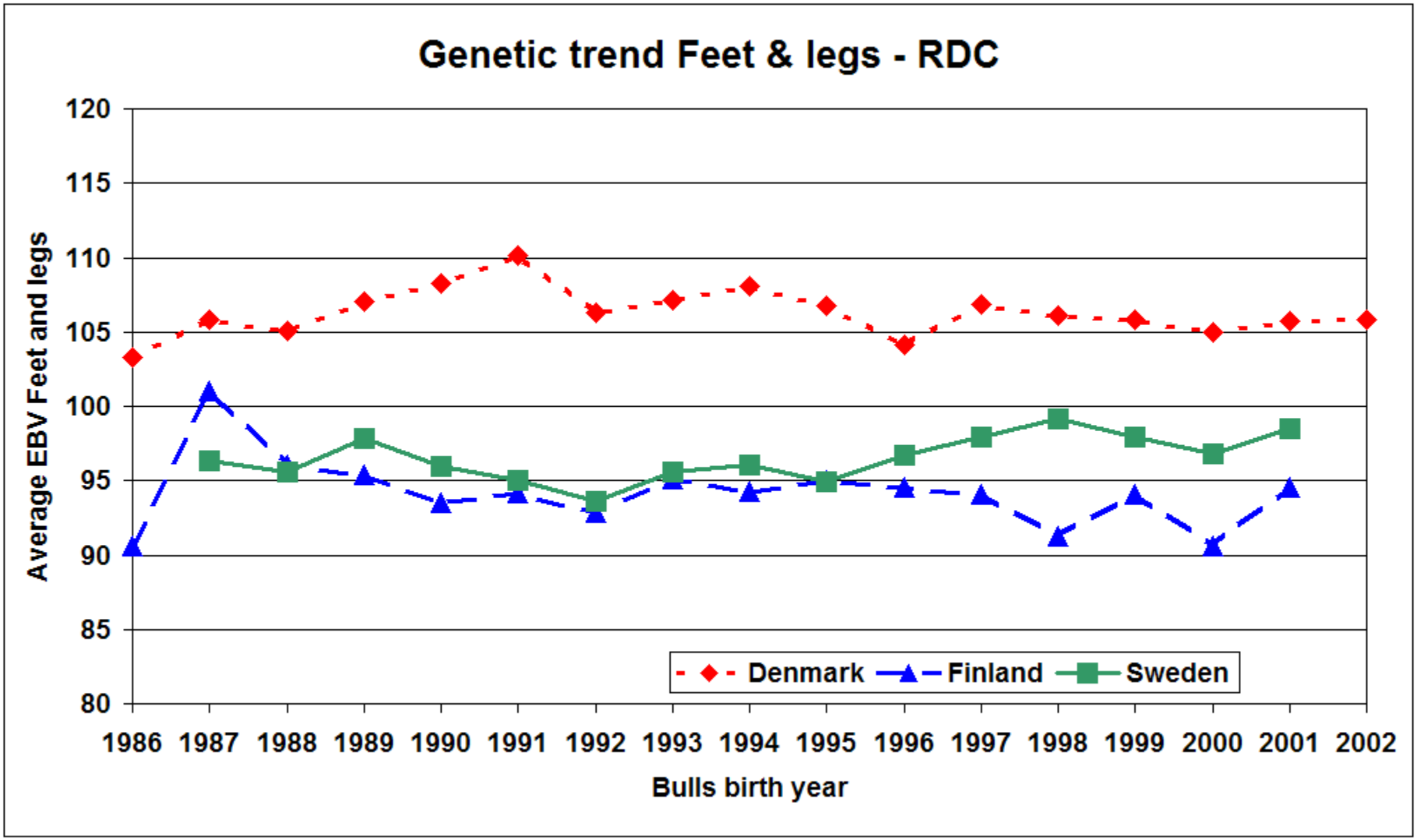
Weight in yield index

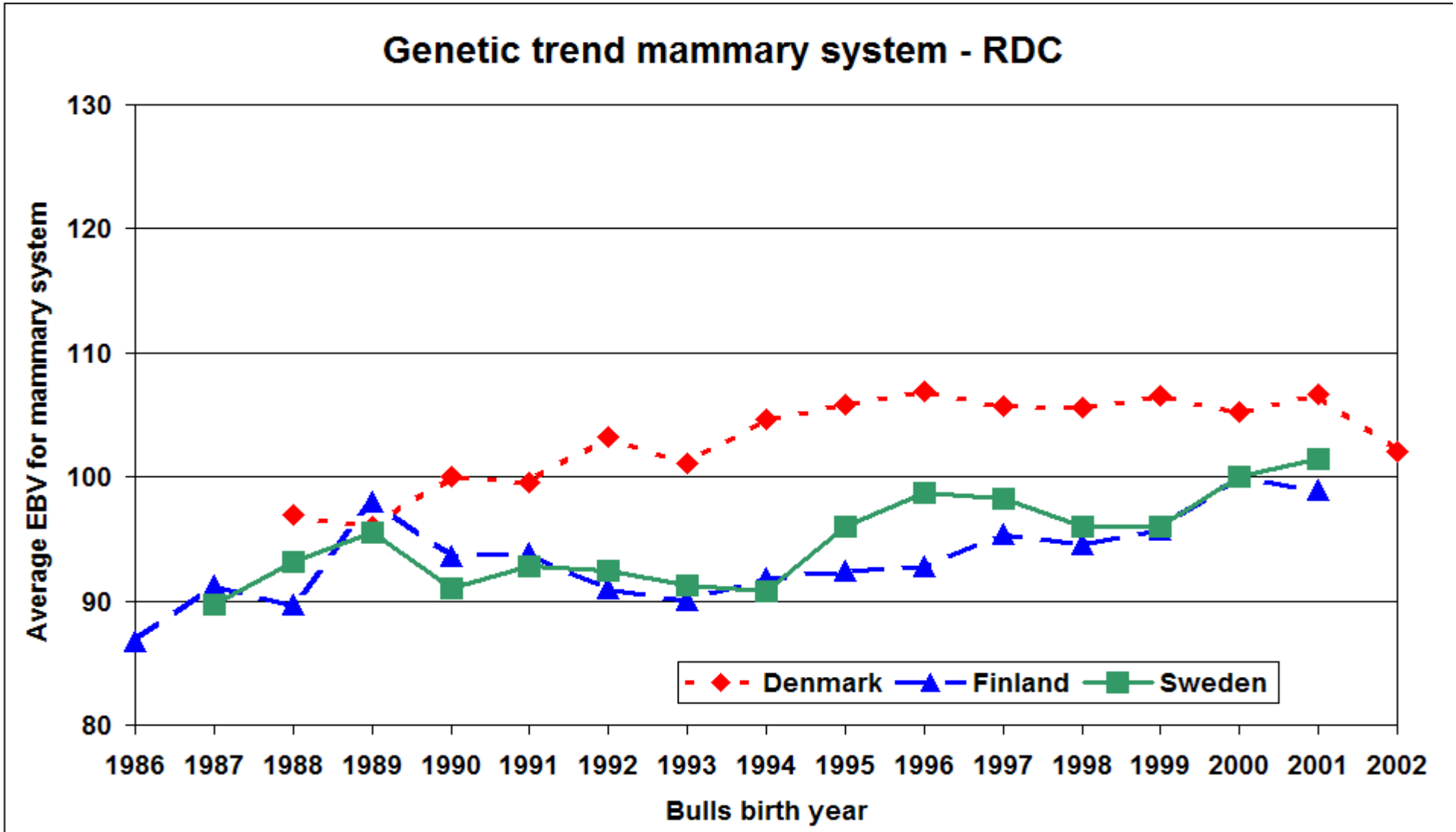
	Both Holstein and Red breeds		
	Milk	Fat	Protein
Nordic	-1	1	4

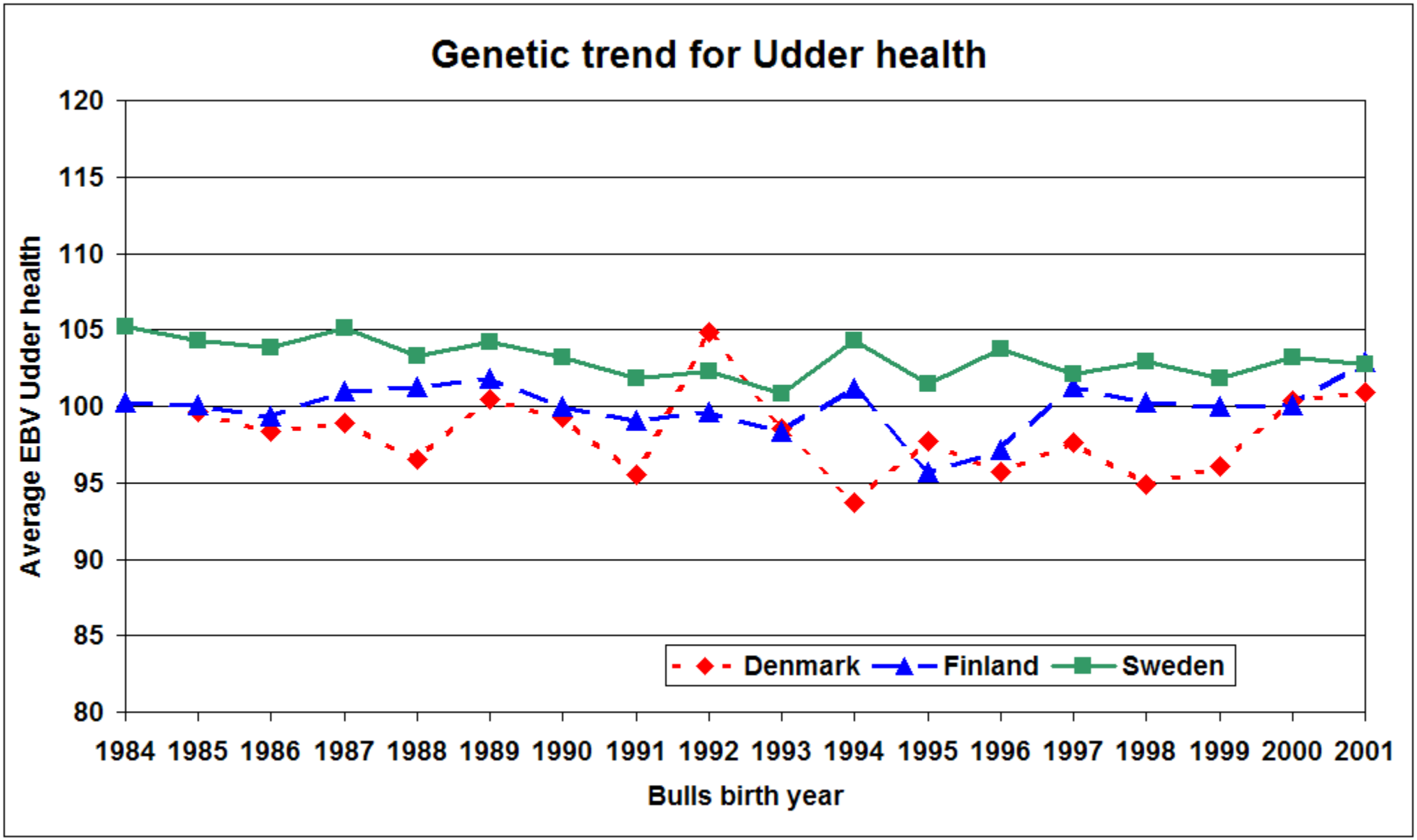
Genetic trend Fertility index




Genetic trend Yield - RDC
Average Yield Index
120
115
110
105
100
95
90
85
80
75
70
65
60
Denmark
Finland
Sweden
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Bulls birth year


Genetic trend Feet & legs - RDC
Average EBV Feet and legs
120
115
110
105
100
95
90
85
80
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Bulls birth year
Denmark
Finland
Sweden

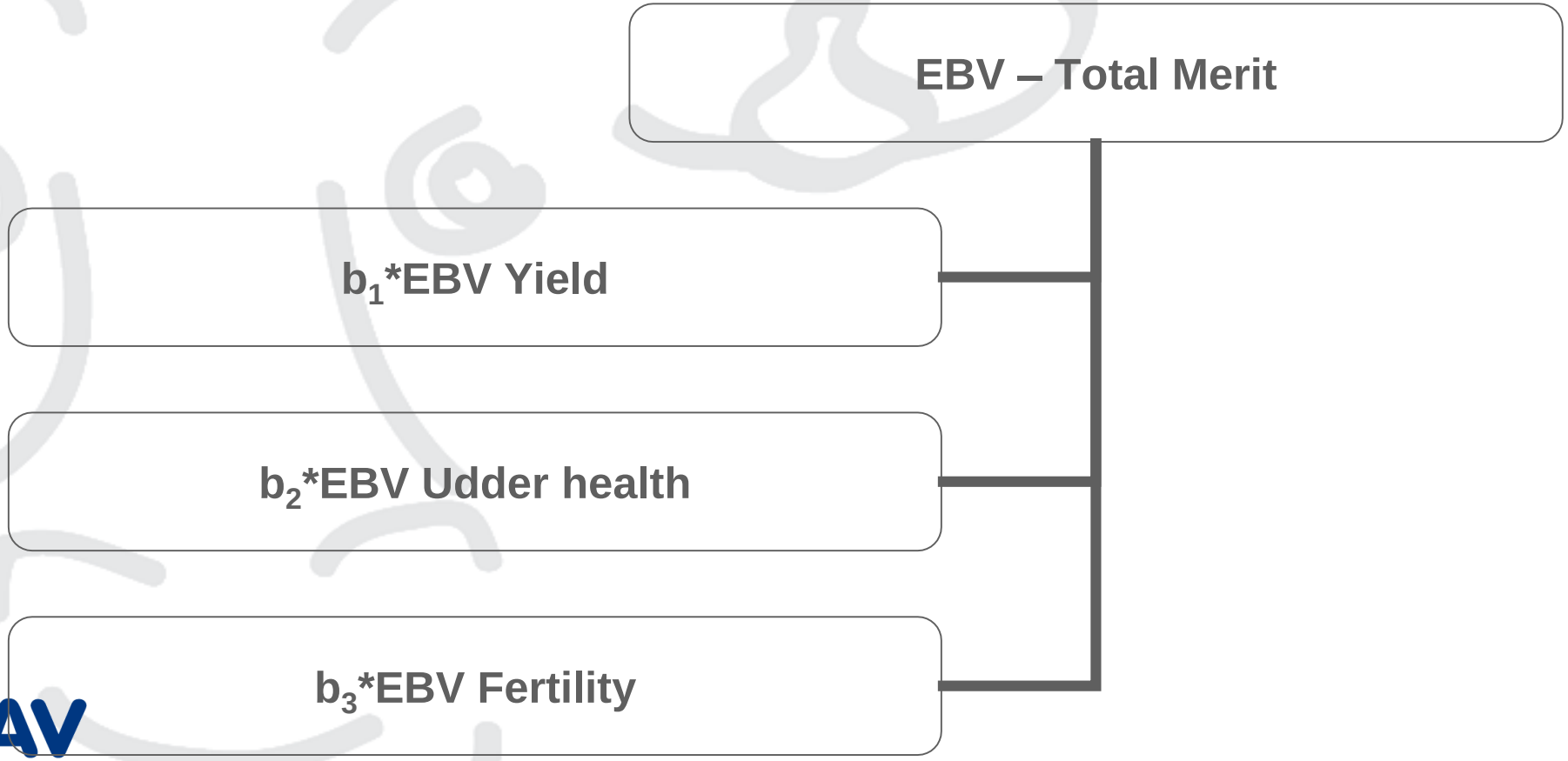

Genetic trend mammary system - RDC
Average EBV for mammary system
130
120
110
100
90
80
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Bulls birth year
Denmark
Finland
Sweden


Genetic trend for Udder health
Average EBV Udder health
120
115
110
105
100
95
90
85
80
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001
Bulls birth year
Denmark
Finland
Sweden

Effect of index for udder health Danish Holstein

Sire's index for udder health	Percentage of cows with mastitis	
	1st parity	3rd parity
≤ 85	21.7%	28.9%
86-95	18.3%	26.0%
96-105	15.3%	23.8%
106-113	13.9%	21.0%
≥ 114	10.7%	17.0%

Total Merit index (+ more trait groups)



Correlation with TMI – Red breeds

	Denmark	Finland	Sweden
Yield	0.73	0.62	0.56
Fertility	0.15	0.22	0.20
Mastitis	0.44	0.32	0.34
Other disease	0.32	-	0.19
Longevity	0.45	0.30	0.50

General about methods

- Use the best methods which can be handled in practice
- Update of genetic parameters
- We have to use our data as efficient as possible
- Focus on supporting the strength of Nordic cattle breeding – functional traits

Estimation of breeding values in the future

- Decisions have to be taken Joint Nordic instead of within country:
  - Registration
  - Methods and models
  - Presentation of EBVs
  - Sub breeding goals
  - Future research and development

Remember

- **10% extra genetic gain has the same value, regardless how we achieve it:**
  - **More accurate registrations**
  - **Better statistical models**
  - **Improved selection procedure**
  - **QTL (SNP)**
  - **Etc.**

Benefits by joint Nordic evaluation

- Efficient use of resources
- More reliable EBVs
- Common platform for AI industry

Conclusion

NAV want to give:

The practical cattle breeding the best selection tool to achieve maximal genetic progress

EBVs can be compared within the Nordic countries

Nordic

1	Cow 9	Finland
2	Cow 5	Sweden
3	Cow 1	Denmark
4	Cow 2	Denmark
5	Cow 6	Sweden