Data Collection and Genetic Evaluation of Health Traits in the Nordic Countries

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1. Introduction
2. Data collection
3. Joint Nordic Genetic Evaluation
4. Genetic evaluation for health traits
5. Future challenges and conclusion

Nordic Cattle Genetic Evaluation
Nordisk Avlsværdivurdering

- **Established 1 January 2002 by**
  - **Finnish Animal Breeding Association**
  - **Swedish Dairy Association**
  - **Danish Cattle Federation**
  - **GENO – Norway (left 31.12.2004)**

Perspectives - Joint Nordic estimation of breeding values

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

Disease - Health

- Diseases
  - Reduce animal welfare
  - Economic losses for farmers extra costs:
    - Veterinarian treatments
    - Labour
    - Decreased production
    - Discarded milk
    - Involuntary culling

Disease - Health

- An improvement of health is desirable from:
  - A general ethical point of view
  - Lead to increased consumer acceptance
  - Economic importance to the farmer

Disease - Health

- An improvement of health can be reached by:
  - Management

  and
  - Genetic

  A good registration system is essential for both management and genetic improvements!

Disease recording

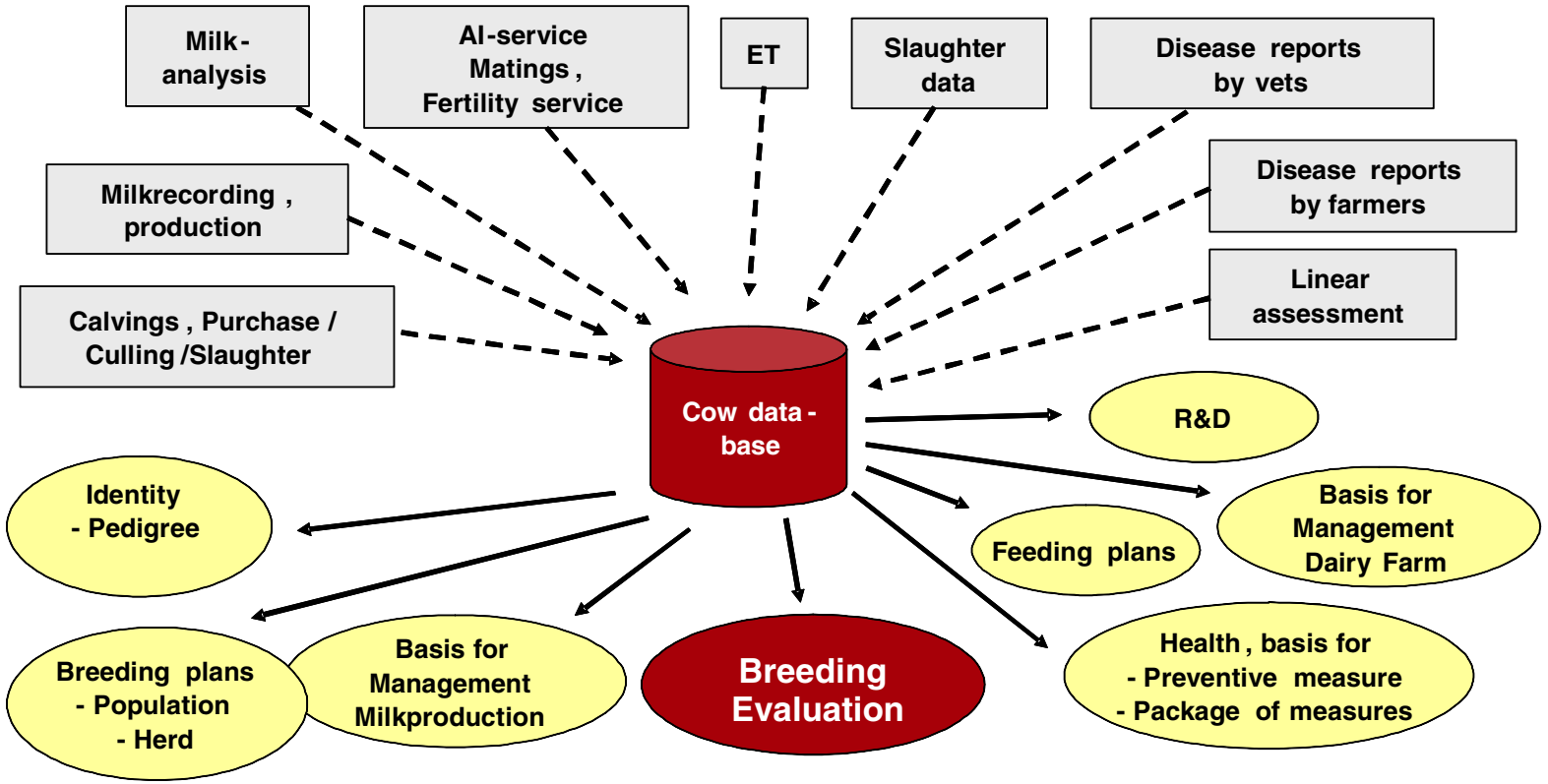
- The systems in Denmark, Finland and Sweden are very similar
- The Danish system is used as an example

Systematic disease recording

- Started in Denmark in 1990 cooperation Danish Cattle Federation and the Danish Veterinarian Society

- Started earlier in Sweden and Finland

Cow database



Data flow in relation to the central data base

Disease recording system

- Transfer from invoicing systems used by veterinarians to the database
- By pencil in a standard system used also for other purposes - Herd manager and veterinarian
- Direct registration in central data by use of EDP software

Disease recording system

- **Direct registration in central data base by use of EDP software is increasing. Now possible both by:**
  - **Traditional disk top**
  - **PDA – Personal Digital Assistance (pocket computer)**

Disease recording system

- Recording of disease diagnoses can be made by both veterinarians and herd manager – double registrations are automatically avoided
- More than 80 different disease codes are used to describe the diagnoses

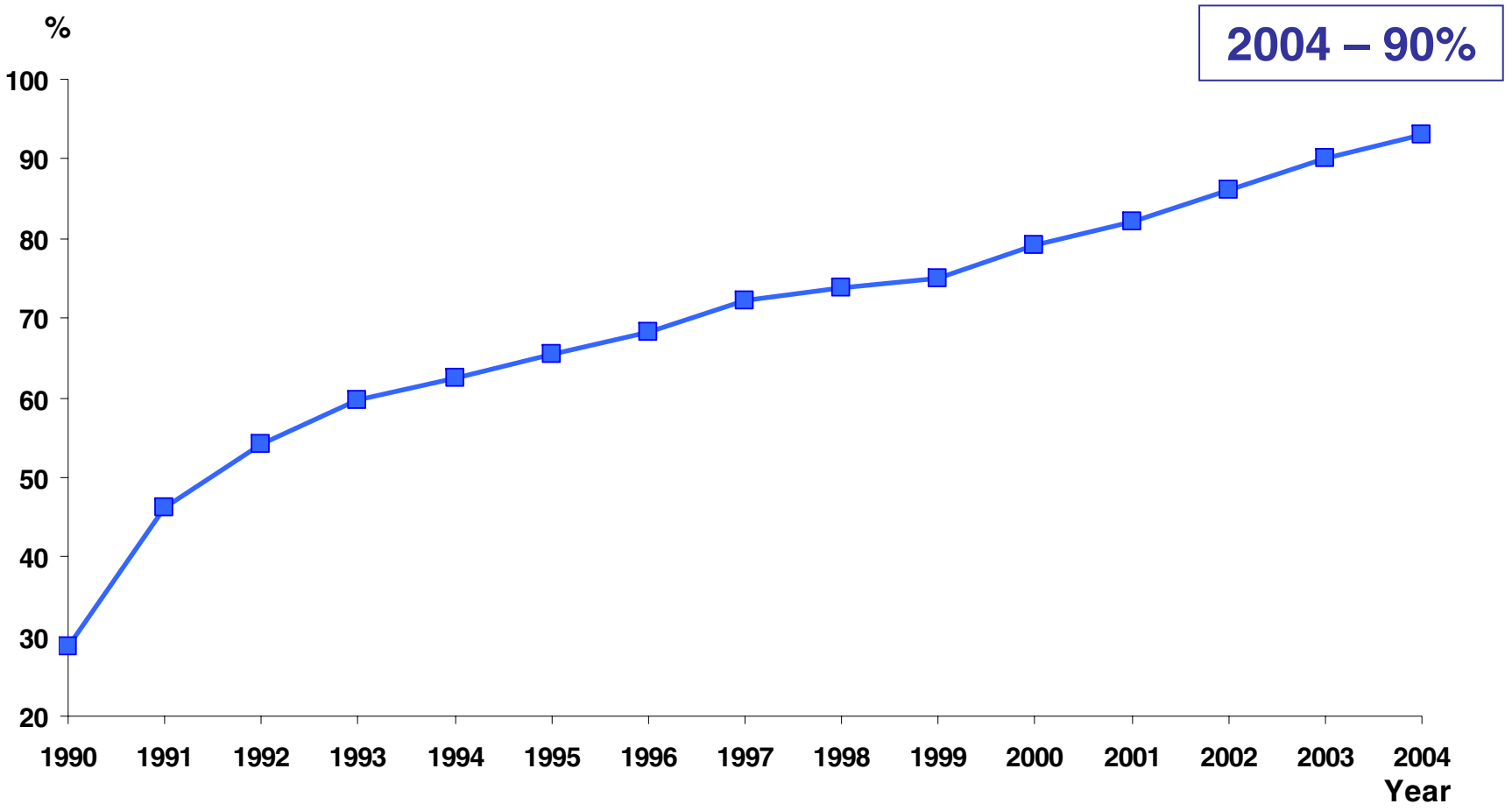
Disease recording system

- For management and breeding purposes the codes are usually pooled within four categories:
  - Udder diseases
  - Reproductive diseases
  - Digestive and metabolic diseases
  - Feet and leg diseases

Disease recording system

- Mandatory in Sweden
- Voluntary in Finland and Denmark
  - Exact figures unknown
  - Simple data rules ensure we know which herds are under systematic disease recording

Proportion of cows in herds with regular disease registration, Danish Holstein



Ownership and access to data

- The data are owned by the farmer
- Veterinarians are not paid for the registrations
- The farmer can give permissions to his advisors including the veterinarian to use his data

Use of the disease records

- **Management purposes (direct benefit)**
  - The farmer and the advisors can get access to several printouts, key figures etc. about the herd combining different registrations in the central database
- **Breeding purposes (important spin-off)**
  - Estimation of Breeding Values

Joint Nordic Genetic Evaluation

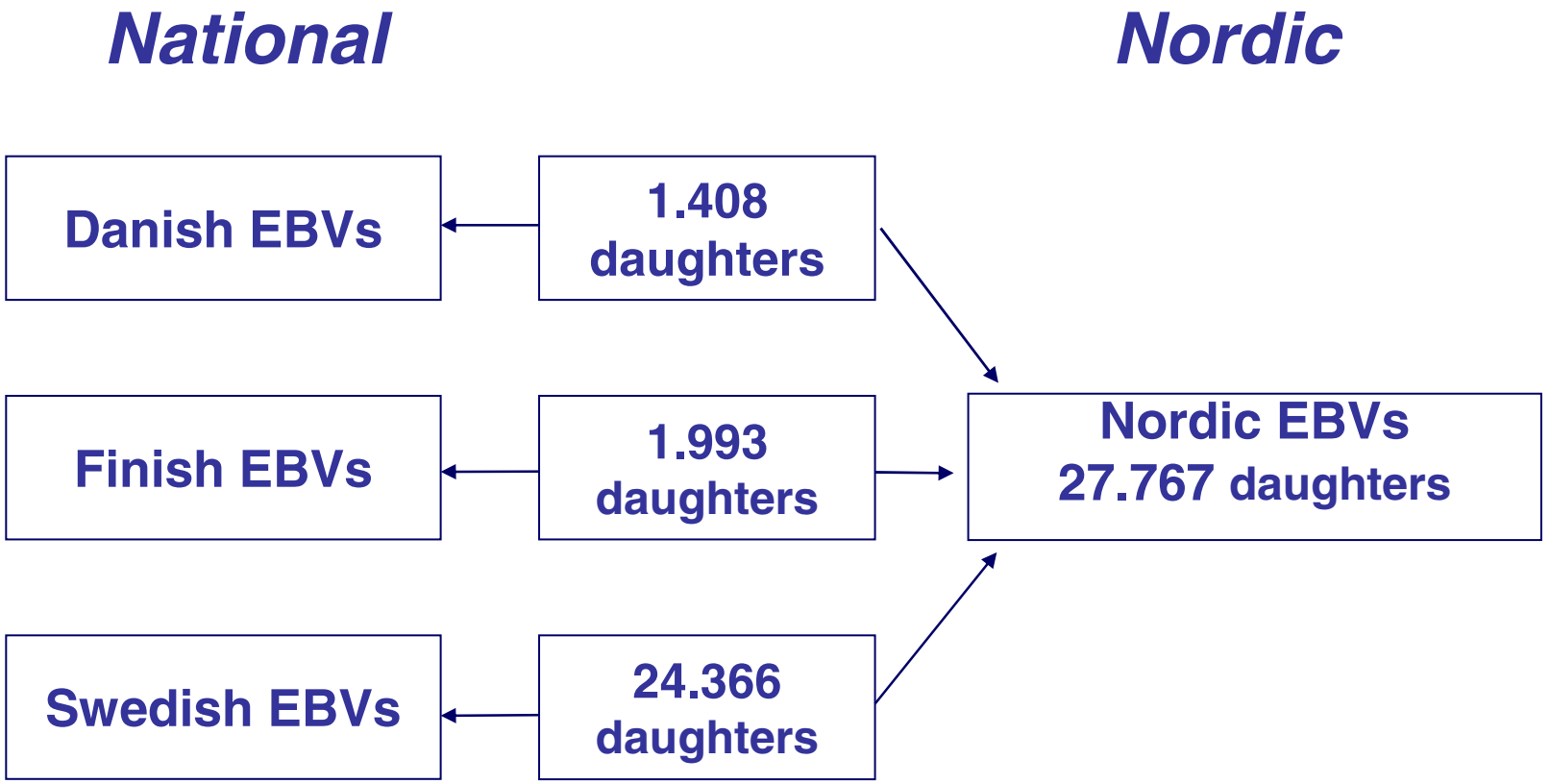
- Responsible for estimation of BVs for cattle in Finland, Sweden and Denmark
- 2002 – Development has started
- 15 April 2005 – first results were published

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

From national to Nordic
SRB-bull Backgård



Breeding values could only be compared within country

Backgård

	Denmark	Sweden	Finland
Number of daughters	1.408	24.366	1.993
Mastitis	Danish	Swedish	Finnish

Backgård – before 15.4.2005

Danish, Finnish and Swedish EBVs could not be compared for any traits:

- **Information from different daughters**
- **Sub breeding goals are different**
- **Differences in genetic level**
- **Differences in standard dev. of EBVs**

Backgård – today January 2006

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

- **Fertility traits (same sub breeding goals)**
- **Type traits (same sub breeding goals)**
- **Temperament and milkability**

Backgård – April 2006

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

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

Jan. 2006 EBVs for fertility and mammary system the same in Denmark, Sweden and Finland

Backgård

	Denmark	Sweden	Finland
Number of daughters		27.767	
Fertility		96	
Mammary system		113	

Estimation of breeding values in the future

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

Traits used in the current mastitis index in Denmark, Sweden and Finland

	Denmark	Sweden	Finland
CM	x	x	x
SCC	x	x	x
Udder conformation	x		

Estimation of breeding values Nordic

- Udder health /mastitis resistance index
  - Clinical mastitis
  - SCC
  - Udder depth, fore udder attachment

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

Mastitis frequency – year 2004

	Red Breeds		
Parity	DNK	SWE	FIN
1st day -15-50	13.8	5.8	6.8
1st day 51-305	8.5	4.5	5.1
2nd day -15-150	19.0	9.5	11.1
3rd day -15-150	25.6	12.9	14.4

Mastitis frequency – year 2004

	Holstein		
Parity	DNK	SWE	FIN
1 day -15-50	13.5	7.2	8.4
1 day 51-305	10.7	7.2	7.5
2 day -15-150	21.7	12.9	13.3
3 day -15-150	25.9	16.6	15.3

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!

EBV – udder health
Nordic Economic weights

- 25% at -15 - 50 days in first parity
- 25% at 50 – 300 days in first parity
- 30% at -15 - 150 days in second parity
- 20% at -15 - 150 days in third parity

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%

Other health traits

- Reproductive diseases
- Metabolic & digestive diseases
- Feet and leg diseases

- Heritabilities 1-3%
- Moderate positive correlations among disease traits
- Based on 1. batch daughters seldom r_{IA}^2>65%

Sire's index for other health traits	Effect of other health index Holstein 3rd parity			
	Percentage of cows with a diagnose			
	Rep.	Dig.	Feet & Legs	Sum
≤ 85	14.4%	12.5%	2.6%	29.5%
86-95	14.6%	9,7%	3,3%	27,6%
96-105	15.9%	9.3%	3.1%	28.4%
106-113	14.6%	8.3%	2.8%	25.6%
≥ 114	12.9%	7.0%	2.7%	22.6%

1) Standard deviation of the index is approx. 10

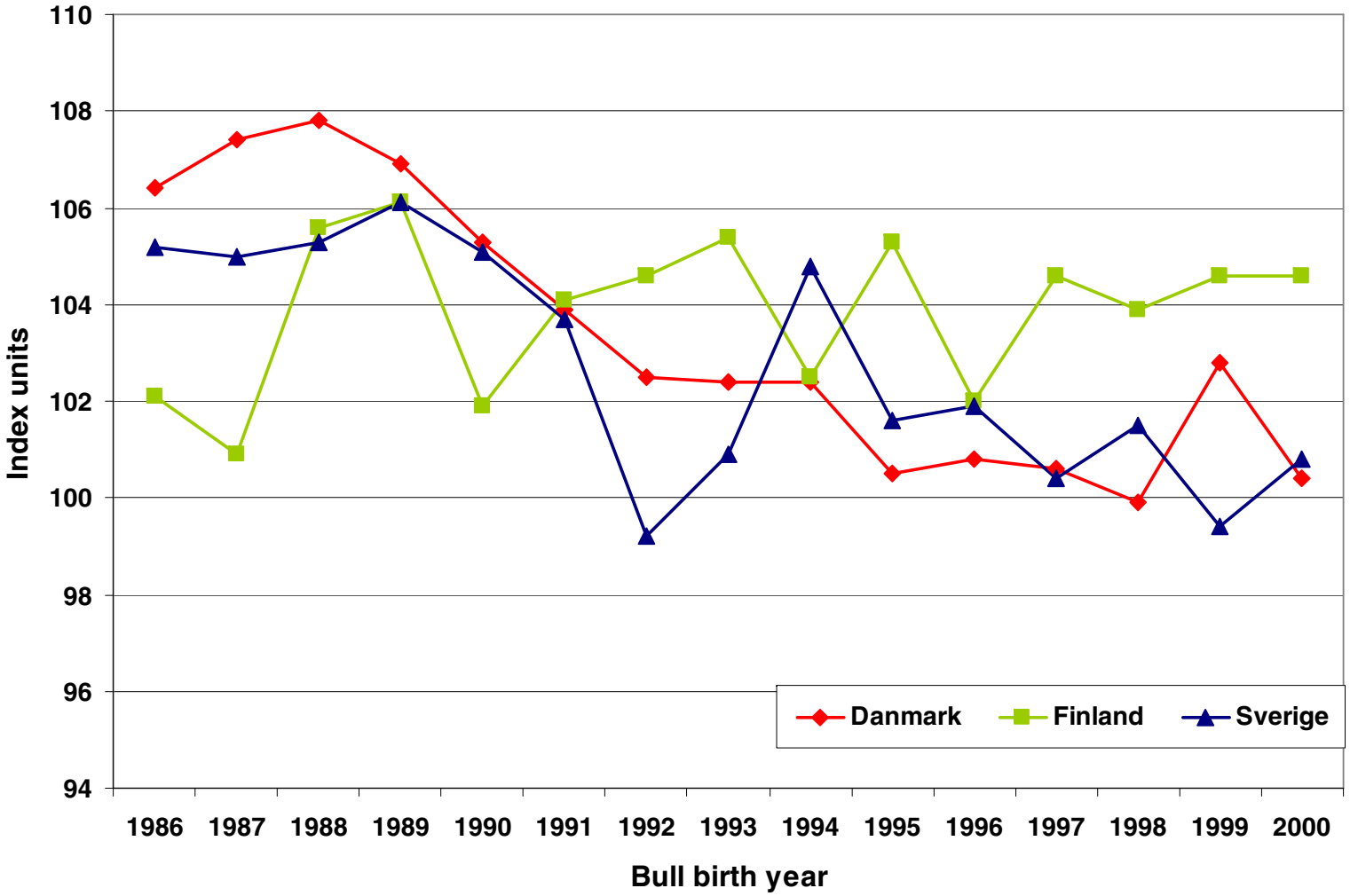
Correlation with TMI – Holstein

	Denmark	Sweden	Finland
Yield	0.67	0.45	0.74
Fertility	0.18	0.40	-0.03
Mastitis	0.35	0.43	0.18
Other disease	0.37	0.24	-

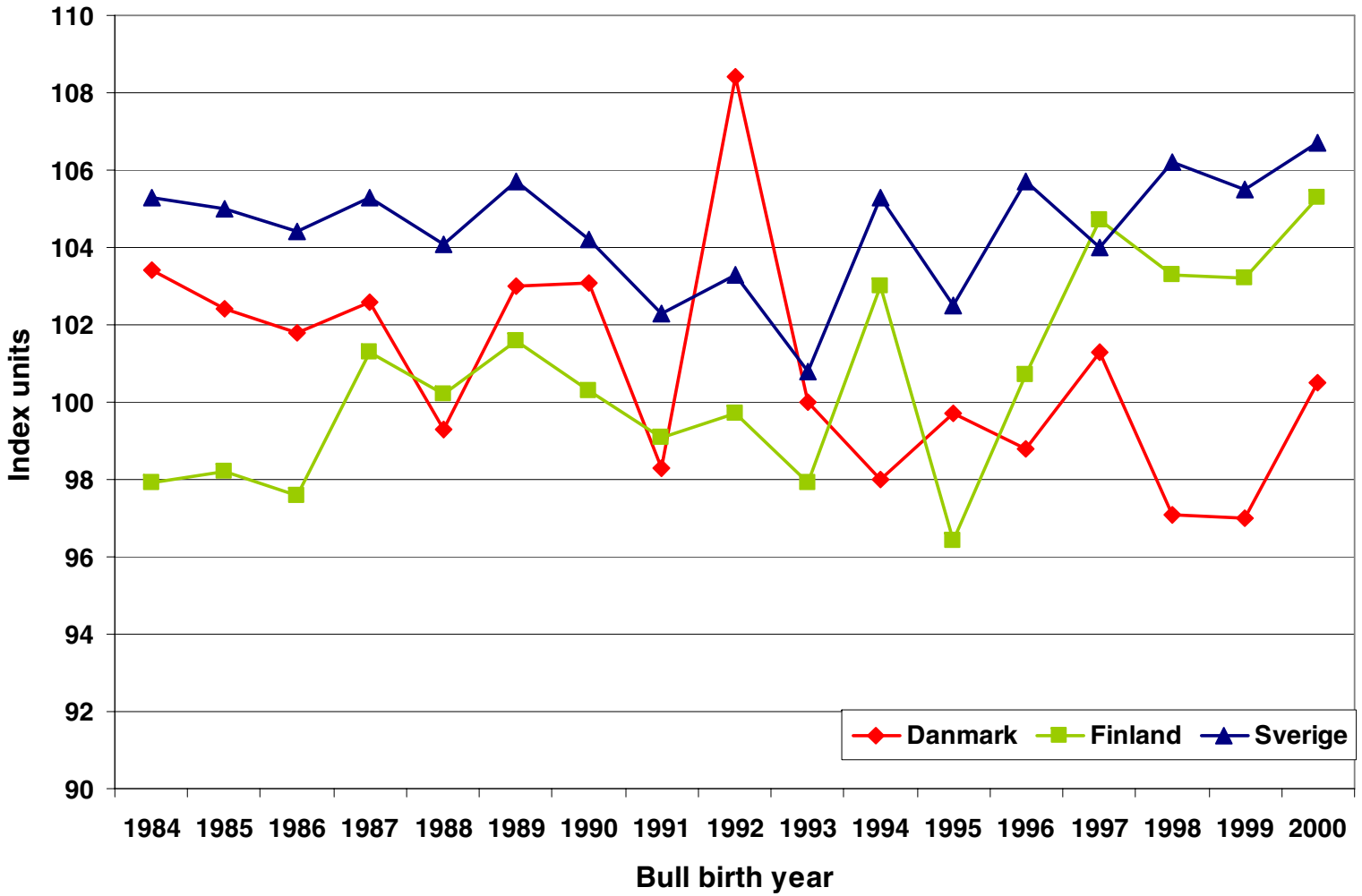
Correlation with TMI – Red breeds

	Denmark	Sweden	Finland
Yield	0.73	0.56	0.72
Fertility	0.15	0.20	0.03
Mastitis	0.44	0.34	0.19
Other disease	0.32	0.19	-

Genetic trend udder health – Holstein



Genetic trend udder health – Red breeds



Future challenges I

Registration:

Develop current system – easier registration

EBVs:

- Model which consider the nonlinear magnitude of the CM data
- Move from lactation model to TD or mixture models for SCC

Future challenges II

Breeding goal and breeding work:

Follow TMI when selecting both proven sires and bull sires

Sires tested outside the Nordic countries important to look carefully at all available information to ensure positive genetic trend

Future challenges III

QTLs might give us important information about disease resistance, but the fundament for finding QTLs is accurate disease registrations in practice

Conclusion - health

- Registration of diseases is a foundation
- Low heritability but large genetic variation
- EBVs use data as efficient as possible
- Economic important
- Has to be included in a breeding goal