# The importance of recording of AI data for the genetic systems

**- the context of AI from service to genetic progress**

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## The changing role of Artificial Insemination

**AI initially used only for**
- Controlling veneral diseases
- Making cows pregnat

**Breeding tool also for**
- progeny testing
- genetic evaluation
- dissemination of genetic material

## The changing role of AI as a breeding tool

- Development and use of frozen semen
- Recording and use of high capacity computers
- Expanded knowledge on genetics of fertility and its associations with production

## Use of frozen semen - effects on breeding programs

***Long time storage of semen***

- **Young bull schemes**
  - collection - use - storage – slaughter
- **Lay-off bull schemes**
  - wide-spread use after progeny testing
- **Trade of semen and globalization**
  - heavy use of individual bulls with known and unknown characteristicsacross countries

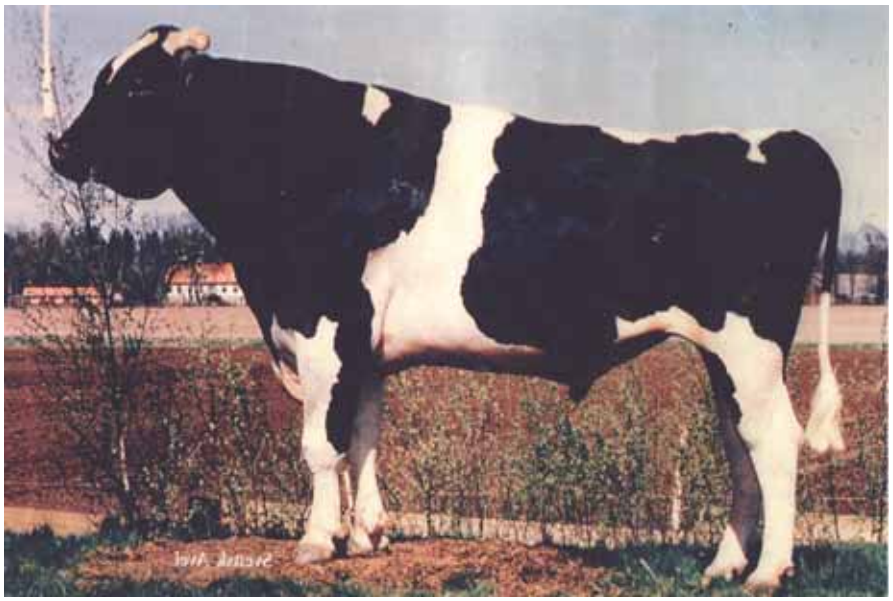
## Dramatic Internationalization of Dairy Cattle Breeding

- The Polish FAO-experiment with 10 HF-strains
- Heavy increase in international trade of semen

***Rapid breed changes in 25 years***

| | |
|---|---|
| ***Friesian*** | ***"Holsteinization" via N.A.*** |
| ***Braunvieh*** | ***Brown Swiss via N.A.*** |
| ***Jersey*** | ***N.Z., USA, Denmark*** |
| ***Ayrshire*** | ***Scandinavia*** |

***(Red breeds)***



## Globalisation of breeding programs

- Semen and embryos available on world market of many breeds for many years
- Market forces very strong but gave no advice on what is best for individual countries
- Breeding values not comparable across countries
- Farmers and AI studs need objective information and breeding values comparable across countries
- Interbull evaluations developed for this purpose

## Percentage of progeny tested bulls with foreign sire

| Breed group | Birth year of bull | | |
|---|---|---|---|
| | 1981-1985 | 1986-1990 | 1991-1995 |
| Brown Swiss | 67.3 | 57.4 | 64.9 |
| Guernsey | 14.6 | 13.0 | 32.7 |
| Holstein | | 60.2 | 59.4 |
| Jersey | 14.9 | 26.1 | 35.0 |
| Red Dairy Cattle | 16.7 | 27.1 | 26.9 |
| Simmental | 23.6 | 26.0 | 28.6 |

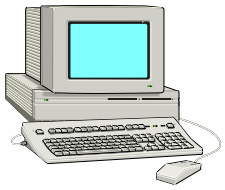
## Participation rate – routine evaluations
## No. of bull populations – April 2008

| Breed | Produc-tion | Confor-mation | Udder health | Calving traits | Long-evity | Female fertility |
|---|---|---|---|---|---|---|
| RDC | 11 | 8 | 10 | 5 | 9 | 6 |
| BSW | 9 | 7 | 8 | 4 | 6 | 5 |
| GUE | 6 | 4 | 5 | | 5 | 4 |
| HOL | 25 | 21 | 23 | 9 | 19 | 16 |
| JER | 10 | 9 | 8 | | 7 | 5 |
| SIM | 10 | | 8 | | 2 | 2 |
| **No. Pop.** | **71** | **49** | **62** | **18** | **48** | **38** |

## Size of Operation

| Breed | No. bulls | No. populations |
|---|---|---|
| RDC | 12 016 | 11 |
| BSW | 7 707 | 9 |
| GUE | 927 | 6 |
| HOL | 101 742 | 25 |
| JER | 8 058 | 10 |
| SIM | 21 315 | 10 |

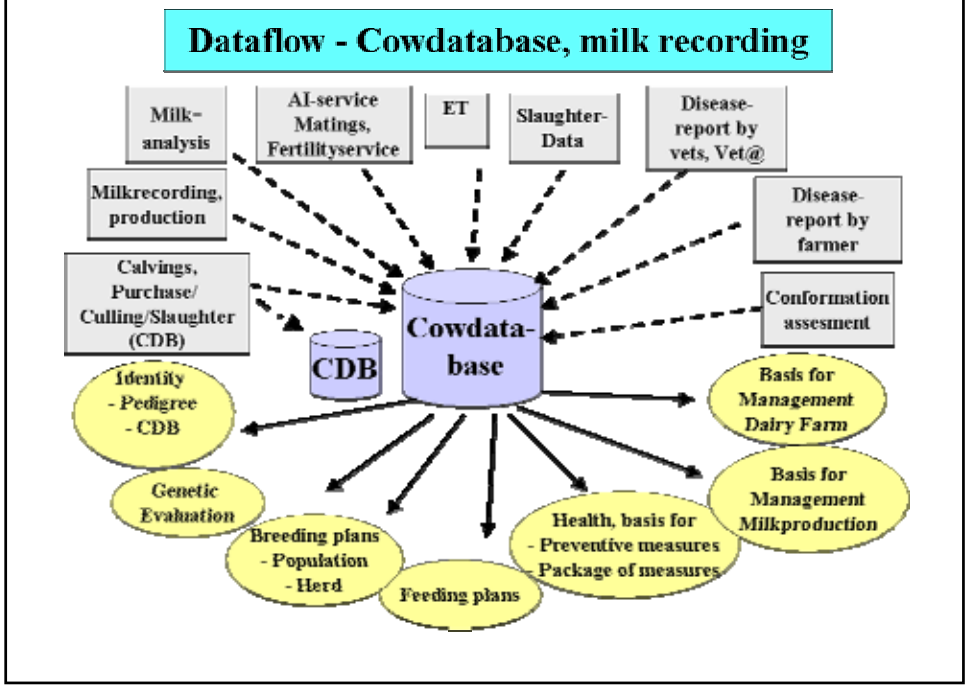
Production traits April 2008



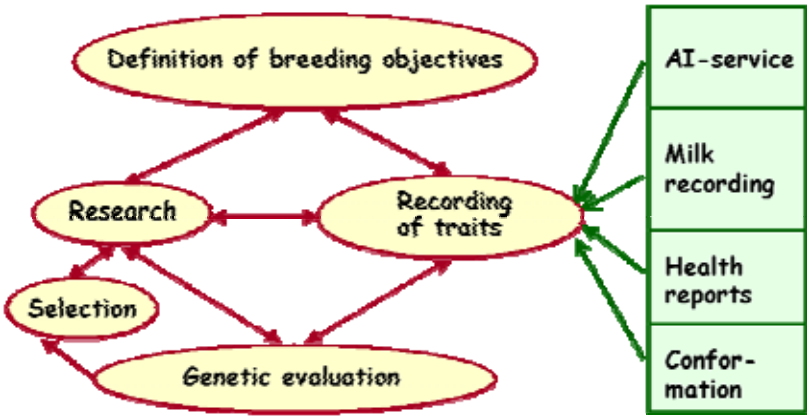
## Computerization of AI-records

- **Monitoring fertility of individual bulls**
  - **Non-Return Rate (%NRR)**
- **Generates pedigree information**
- **Integrated data bases to be used for management information and research**

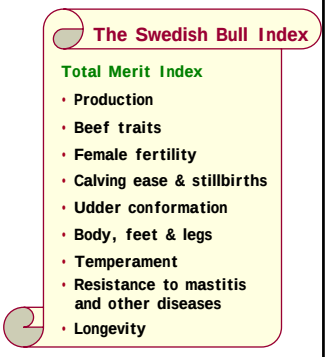
***Accurate and complete recording of inseminations and calvings necessary***




## Interactive parts of a breeding program with integrated data base information



## Recording and integration of data important for Total Merit Indexes




- Herd-books integrated into the milk-recording scheme
  - many countries have different organisations for each activity; costly and less efficient!
- The computer checked identities and pedigrees enable genetic analyses of all traits
- Integration of cow data from different sources started already in the 1960´s in Sweden
  - allowed early use of data for research to develop selection programs including fertility traits

## Development of AI-services

### Fewer/larger AI companies

- **Multinational**
- **Private**
- **Farmer cooperatives**

### From technicians to herdsmen doing AI

- **Employed technicians**
  - accurate and complete recording
- **Do - it - yourself AI**
  - accuracy in recording?

## Female fertility
## - a complex of interacting traits

**Three categories of traits:**

- **Ability of virgin heifers to show visible estrus**
- **Ability of the lactating cow to resume the reproductive cycle post-partum and show visible heat**
- **Ability to conceive following insemination**

**Fertility in virgin heifers and lactating cows different traits**
**- genetic correlation 0.6-0.7**

## Female fertility
## - different measures

- **Indirect measures of conception rate:**
  - **Non Return Rate % (after e.g. 28, 56 days)**
  - **No. of inseminations per serviced animal**
- **Interval measures**
  - **Calving – first ins.; Days open; Calving interval**
- **Other measures**
  - **Activity meters (pedometer)**
  - **Progesteron profiles**

## Female fertility shows……

- low heritability: usual range 0.02 – 0.04
- but…
- large additive genetic variation!

- Large variation among daugher groups:
  15-20 % in Conception rate
- Genetic stand. dev. 6-8% vs 8-10% for milk yield
- Large progeny groups for accurate BVs:
  100-150 daus

## Research shows

- Unfavourable genetic correlations between some functional traits and production

| | |
|---|---|
| Clinical mastitis | 0.3 – 0.4 |
| Female fertility | 0.2 – 0.5 |

Angularity, dairyness (sharpness) show unfavourable genetic correlations to fertility (0.4 -0.6) in Holstein

***Direct selection for female fertility necessary to avoid decline in fertility !***

## Research and empirical experience show

**The Swedish Bull Index**

**Total Merit Index**

- Production
- Beef traits
- Female fertility
- Calving ease & stillbirths
- Udder conformation
- Body, feet & legs
- Temperament
- Resistance to mastitis and other diseases
- Longevity

- Combined selection for improvement of both production and fertility is possible!
- Total Merit Index with proper weights on functional traits a necessity for maintained health and fertility
- TMI-index selection result in 10-25% more economic gain than single trait selection for production

## Average genetic correlations ($r_g$) across different Holstein populations

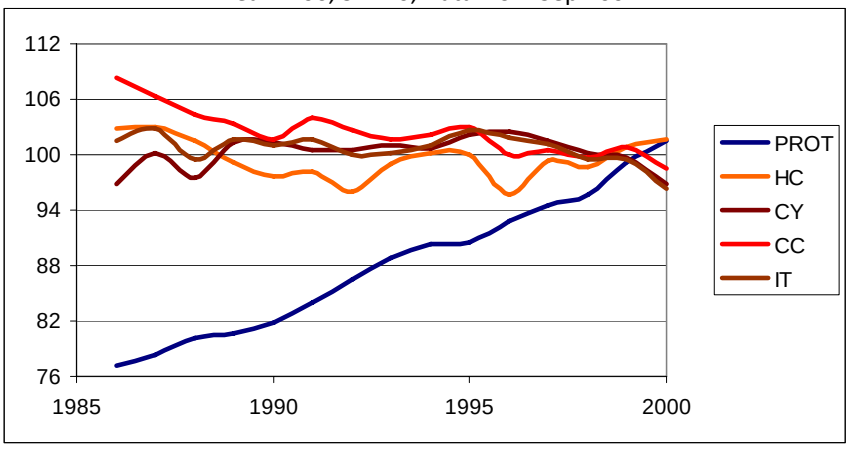
| Trait | Populations | Mean $r_g$ |
|---|---|---|
| Protein yield | 25 | 0.84 |
| Somatic cells | 23 | 0.90 |
| Clinical mastitis (only DFS, DNR) | 2 | - |
| Longevity | 19 | 0.66 |
| Direct calving ease | 9 | 0.80 |
| Maternal calving ease | 8 | 0.77 |
| Direct stillbirth | 5 | 0.74 |
| Maternal stillbirth | 5 | 0.78 |
| Interval calving-first ins. | 7 | 0.90 |
| Non-return rate | 7 | 0.77 |
| Days open/calving interval | 8 | 0.86 |

## Global genetic trends in female fertility differ between breeds!

- **Global genetic trends for bull poulations can be calculated from the Interbull results**
- **Differences between breeds reflect the selection of sires to produce sons in the past 10-20 years**
- **Example of Holstein and Red Dairy Cattle breeds**

## Global trends in protein and female fertility for Red Dairy Cattle bulls

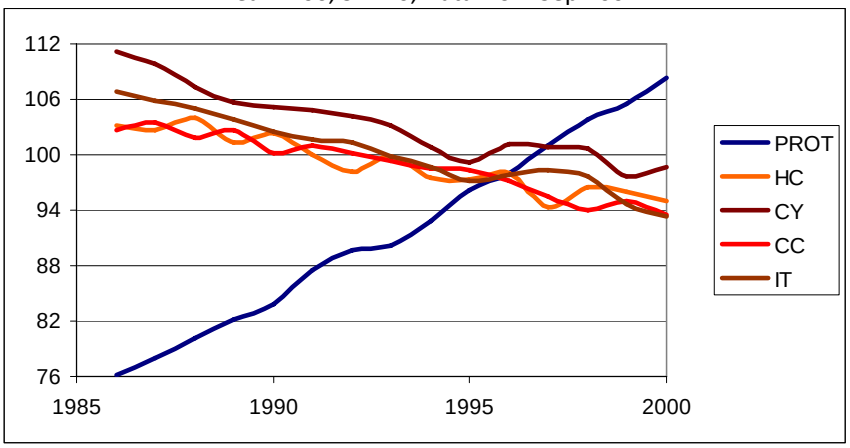
International breeding values, all bulls
Mean=100, SD=10, Data from Sep 2007




PROT= Protein yield, HC=Heifer conception, CY=Cow re-cycling ability, CC=Cow conception, IT=Interval traits (days open/calving interval)

## Global trends in protein and female fertility for HOLSTEIN bulls

International breeding values, all bulls
Mean=100, SD=10, Data from Sep 2007




PROT= Protein yield, HC=Heifer conception, CY=Cow re-cycling ability, CC=Cow conception, IT=Interval traits (days open/calving interval)

## Conclusions

- Reliable recording of AI is crucial for
  - accurate pedigrees
  - opportunities for genetic analyses of all traits
  - opportunities for estimation of BVs and selection for female fertility
- Including female fertility in TMI with proper weight possible to avoid a continuous decline in fertility
- International evaluation of bulls for female fertility offers new opportunities for selection