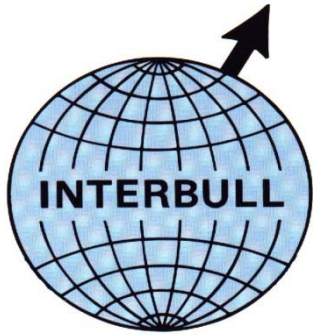


The 29th European Holstein
and Red Holstein Conference
5th of July 2011 in Stockholm

Genetic trends in important traits and inbreeding

J. Philipsson, V. Palucci and J. H. Jakobsen

*Interbull Centre, SLU, PO Box 7023,
75007 Uppsala, Sweden*

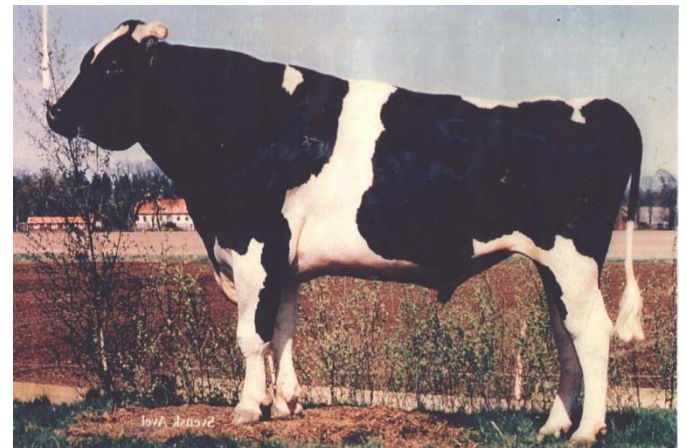


What characterizes sustainable breeding programs?

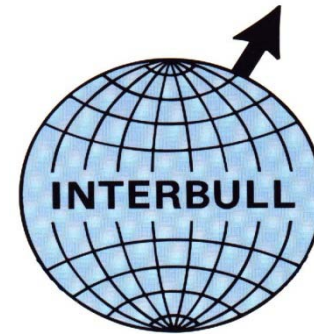
- Efficient production according to long term market needs
- Broad breeding objectives including both production and functional traits incl. health
 - "Robust cows" important for both economy and Animal Welfare
- Efficient selection for achievement of the breeding objectives in different environments/parts of the world
- Management of inbreeding as a result of selection to provide for future genetic diversity

Dramatic globalization of Dairy Cattle Breeding

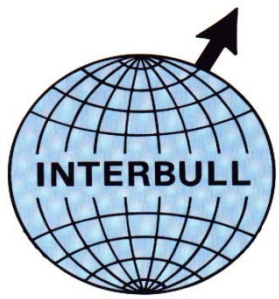
- The Polish FAO-experiment in the 1970-ies with 10 HF-strains gave facts for increased international trade of semen and embryos
 - genetic levels of populations at a given time were shown
 - heavy global use of individual bulls without knowledge on how to compare breeding values across countries
 - the "holsteinization" of Friesian strains took place



Dramatic globalization of Dairy Cattle Breeding



- **Development of MACE (Multiple Across Country Evaluations) and Interbull Centre in the 1990-ies for improved globalised breeding programs**
 - enabled comparisons of bull's breeding values across countries allowing well informed decisions on importations
 - all bulls' breeding values expressed on the country scale and base of the country for their use
 - win-win situation for both exporters and importers



The development of broad breeding objectives

- Traditionally selection for production and conformation
- Functional traits health, fertility and calving came later
- Health and fertility traits negatively correlated with production
- Conformation traits reflecting angularity, dairyness or "sharpness" also negatively correlated with fertility
- The needs for Total Merit Indexes including health and fertility have become obvious, which is reflected in no. of countries for different traits in Interbull evaluations



No. of populations participating in Interbull evaluations by breed and trait group

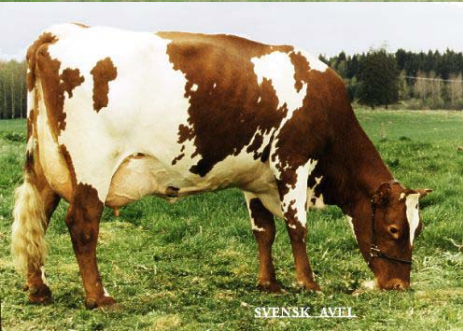
	Prod	Conf	Udder health	Longevity	Calving	Fertility	Workability
Start	1994	1999	2001	2004	2005	2007	2009
BSW	10	7	9	9	5	7	5
GUE	6	4	5	5	-	4	-
HOL	28	21	27	18	12	18	6
JER	11	9	8	7	3	8	4
RDC	13	8	12	7	3	7	3
SIM	11	-	9	3	3	2	-
Total	79	49	70	49	26	46	18

Monitoring genetic trends and inbreeding

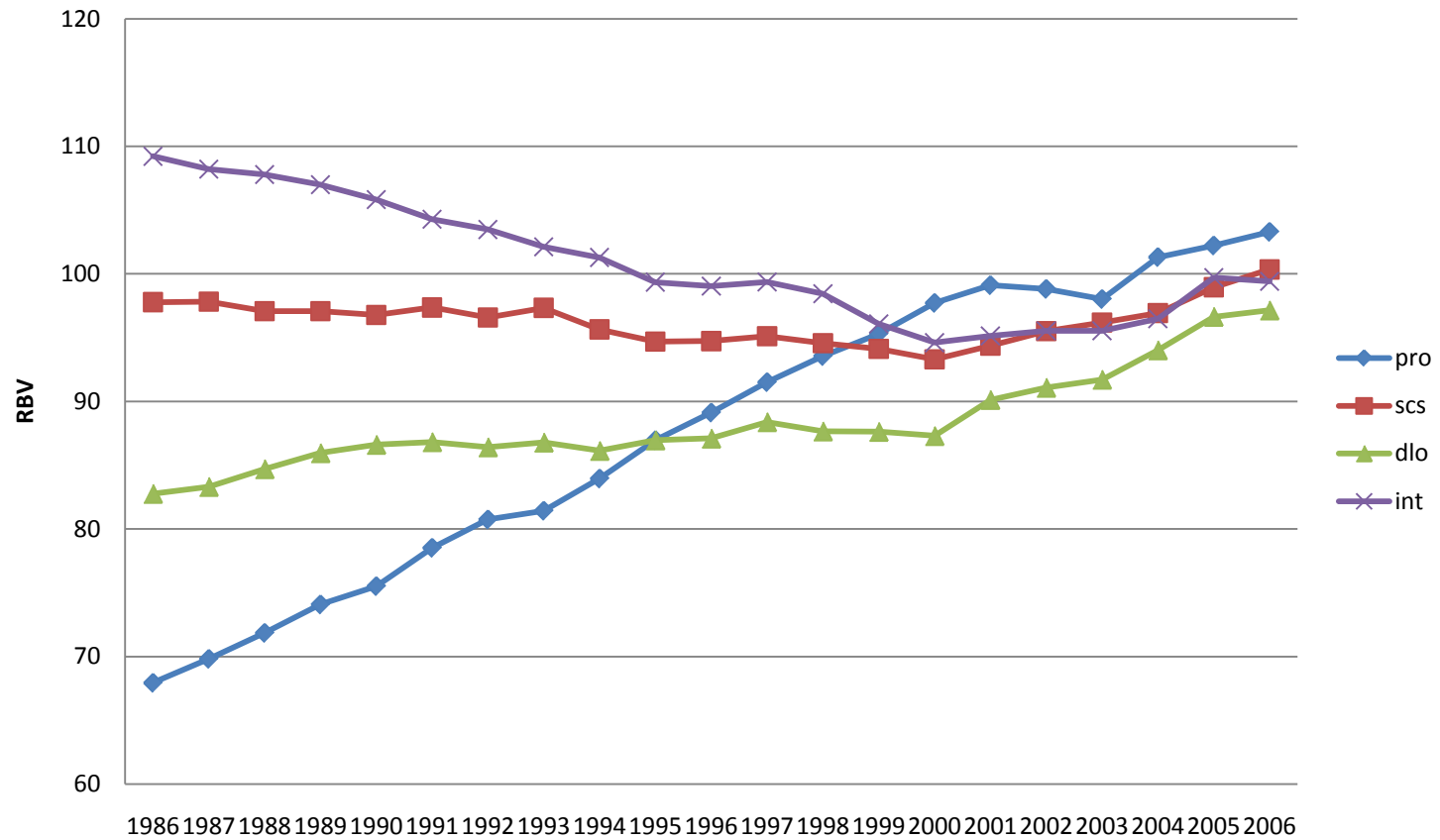
- Necessary to regularly study the achieved genetic change in important traits
 - nationally and internationally
 - are the goals effectively reached?
 - advice on change in emphasis/direction of selection
- Assuring genetic diversity for future use
 - managing inbreeding



Interbull data base excellent source of information for monitoring trends of 6 breeds



Global genetic trends for HOLSTEIN for protein, somatic cell scores, longevity and fertility on DFS scale

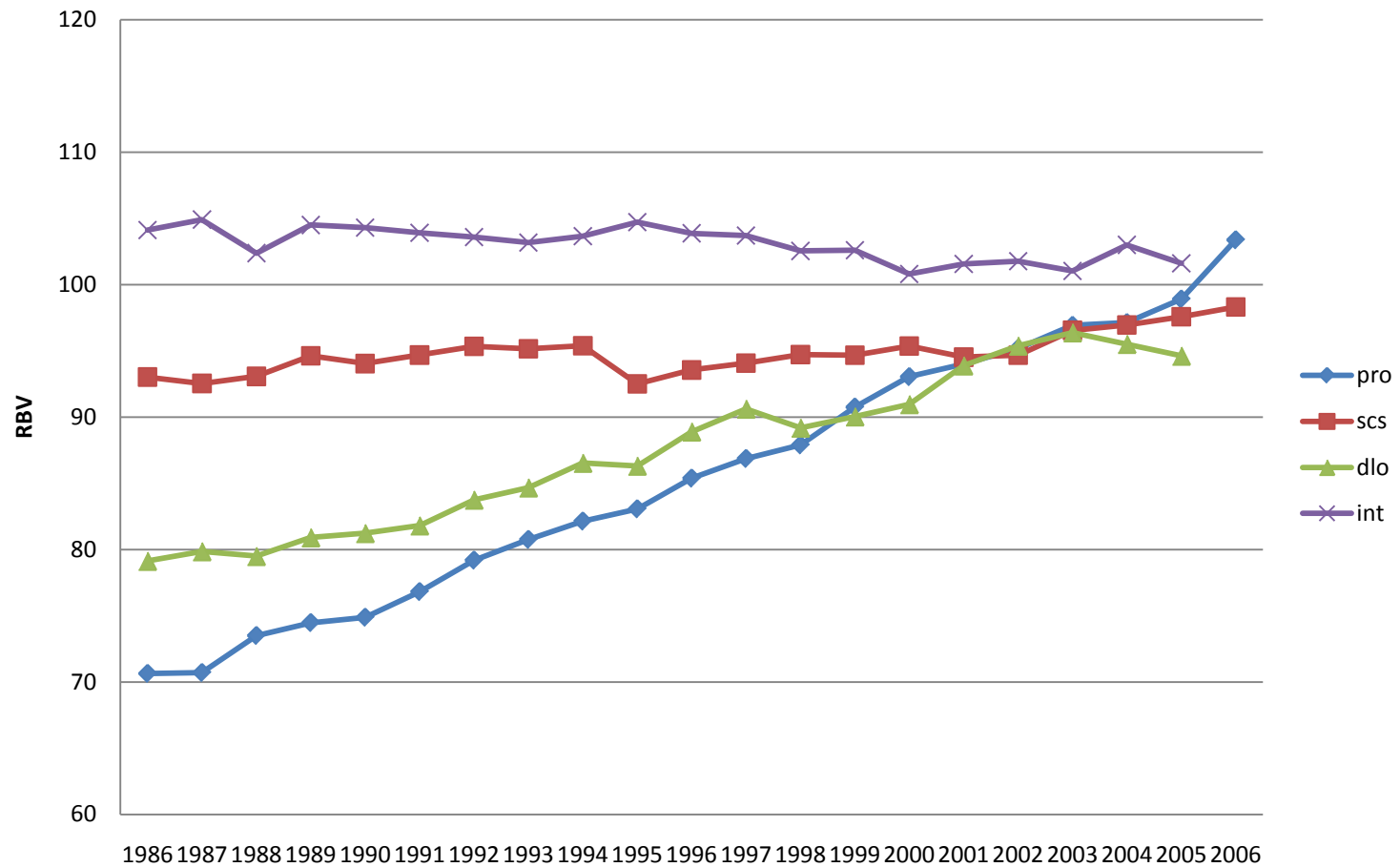




Genetic trends - Holstein

- Tremendous increase in production, but...
- Clearly declining cow fertility, although levelling out
 - Correlated effect of selection for production and "dairyness"
 - No direct selection for female fertility when choosing bull sires in major populations until lately
 - Effects of increased inbreeding rate?
- Unchanged udder health (SCS), or slightly improving
- Improved productive life

Global genetic trends for Red Dairy Cattle for protein, somatic cell scores, longevity and fertility on DFS scale





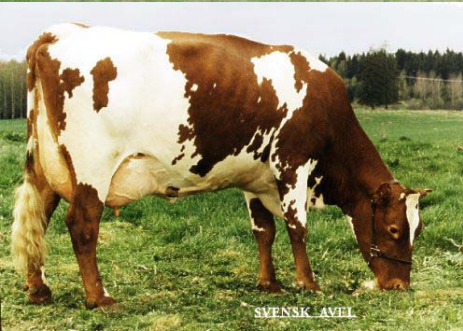
Genetic trends

- Red Dairy Cattle breed group**

- Tremendous increase in production, as large as Holstein...
- and almost unchanged cow fertility
 - Direct selection for female fertility has taken place for more than 20 years when choosing bull sires by including female fertility with proper economic weight in Total Merit Index
- Slightly improved udder health (SCS)
- Clearly improved productive life

Study of inbreeding rates globally by breed

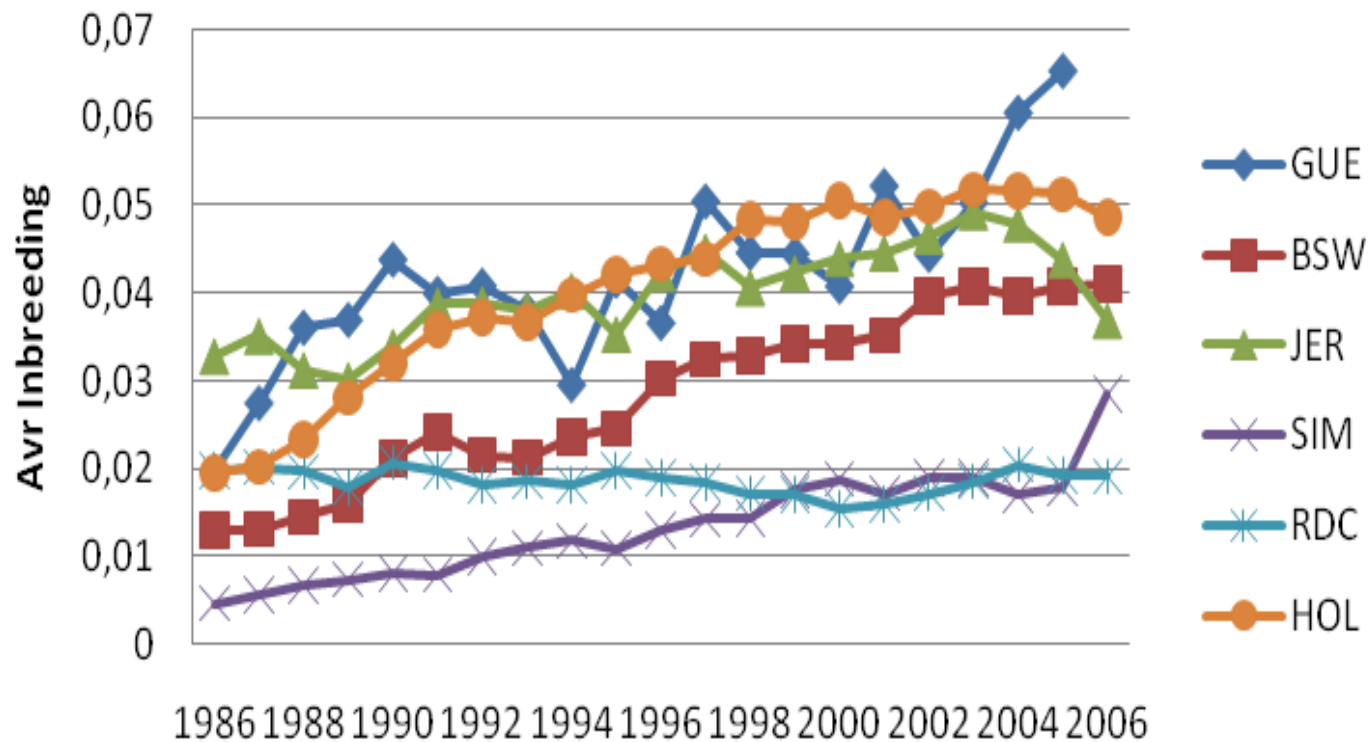
- Previous studies usually by country – fragmented info
- Normally 0.5-1.0% increase in inbreeding level per generation is accepted / manageable
- Only complete (> 80% for 5 generations) pedigrees can be used for estimation of inbreeding rates
- The Interbull data base has recently been updated with sire – dam pedigrees



No. of bulls with Interbull production proofs
born after 1985 with pedigree completeness
(PC) >80% used for inbreeding study

Breed	Total no. bulls	No. bulls PC>0.8	% bulls PC>0.8
BSW	7772	7555	97
HOL	119703	112795	94
GUE	700	625	89
JER	8492	7556	89
RDC	10671	8846	83
SIM	20807	18536	89

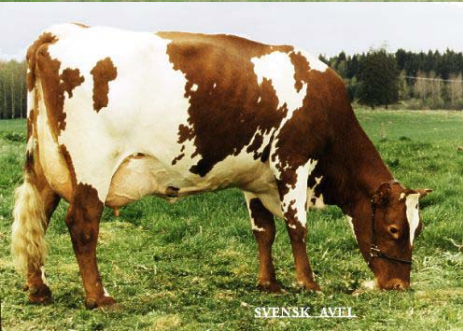
Mean inbreeding pr birth year of bull with production proof and PC > 0.8



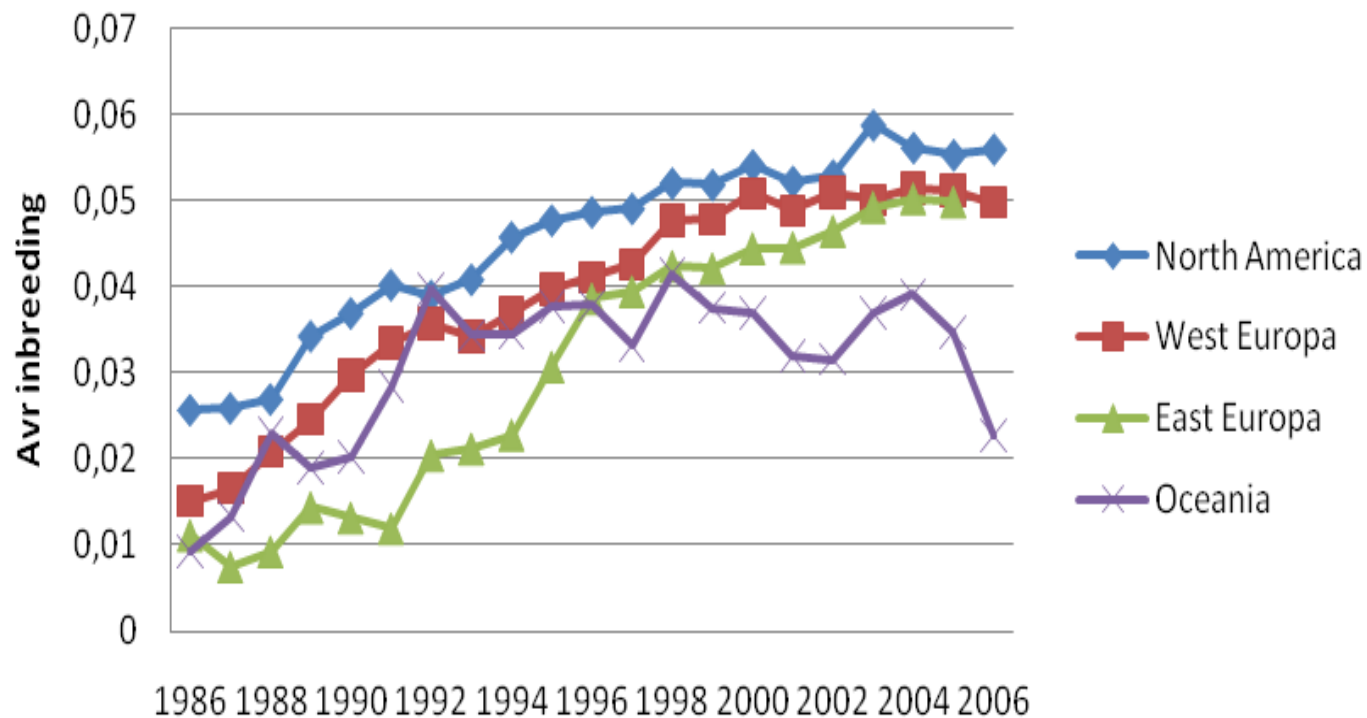
Inbreeding rates globally by breed

- Strong increase in inbreeding level for Guernsey, Jersey, Brown Swiss and Holstein
- For Holstein 3% increase in 12 years (2 generations)
 - too high rate, but levelling out in recent years
- For Simmental and RDC smaller changes
- For Jersey a dip in recent years due to crossbreeding

- Kiwi cattle in New Zealand!
- High inbreeding rate USA



Mean inbreeding pr birth year of HOL bull for "part of the world" first registration





Inbreeding rates by region - Holstein

- High inbreeding rates in both North America and Europe following the "holsteinization"
 - above recommended rates
 - highest increase in Eastern Europe – later "holsteinization"
- The lowered trend in Oceania is due to crossbred bulls (Holst x Jersey) in New Zealand
- Important to increase the genetic base for selection
- Studies on effects of inbreeding in different breeds needed



Most used bull sires (no. proven sons born 1986-95)

Blackstar	(Chairman)	1890
Prelude	(Starbuck)	1594
Starbuck	(Elevation)	1509
Leadman	(Tradition)	1376
Aerostar	(Starbuck)	883

Origin of 10 most used bull sires

Born 1986-95

6 USA

4 CAN

Concentrated use
of few sire lines

Born 1996-2005

4 USA

2 CAN

2 FRA

1 NLD

1 GBR

Broader use of sires, but...



Considering inbreeding

- Genomic selection offers new opportunities to manage inbreeding
 - better measures of real homozygosity are possible for use instead of statistical probabilities of relationships
- Monitoring inbreeding at regional level important
- Practising "Optimum Contribution Selection" for selection of bull sires important
 - considers both EBVs and genetic relationships with previously used bulls
- Research on effects of inbreeding on production, health and fertility urgent



Monitoring international dairy breeds - some conclusions

- Monitoring **genetic trends** on the global scale provides information for possible needs of adjusting breeding goals
 - increased attention to fertility and animal welfare traits
- Monitoring **inbreeding rates** at the global level necessary
 - high inbreeding rate but less problems in later years due to broader use of bull sires
- Improved opportunities with genomic selection, but needs serious attention at regional and global level
- Interbull data base will continuously provide important facts for breed improvement actions



Thank you!

