

A blue-tinted photograph of the ETH Zurich building, showing a large dome and arched windows, set against a background of mountains.

Sustainable breeding programmes of Braunvieh and Fleckvieh in Switzerland and neighbouring countries

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Initial remarks

- **Braunvieh and Fleckvieh as main stream dairy cattle breeds (besides Holstein) in Western Europe**
- **Switzerland as an example**

Fimland 2007: Elements of sustainable breeding goals

- **Marketable products**
- **Functionality of individuals**

Content

- **History of breed development**
- **History of estimation of breeding values**
- **Development of breeding goals**
- **Breeding programmes**
- **Genetic diversity**
- **Benefits from Interbull services**
- **Conclusions and Trends**

Content

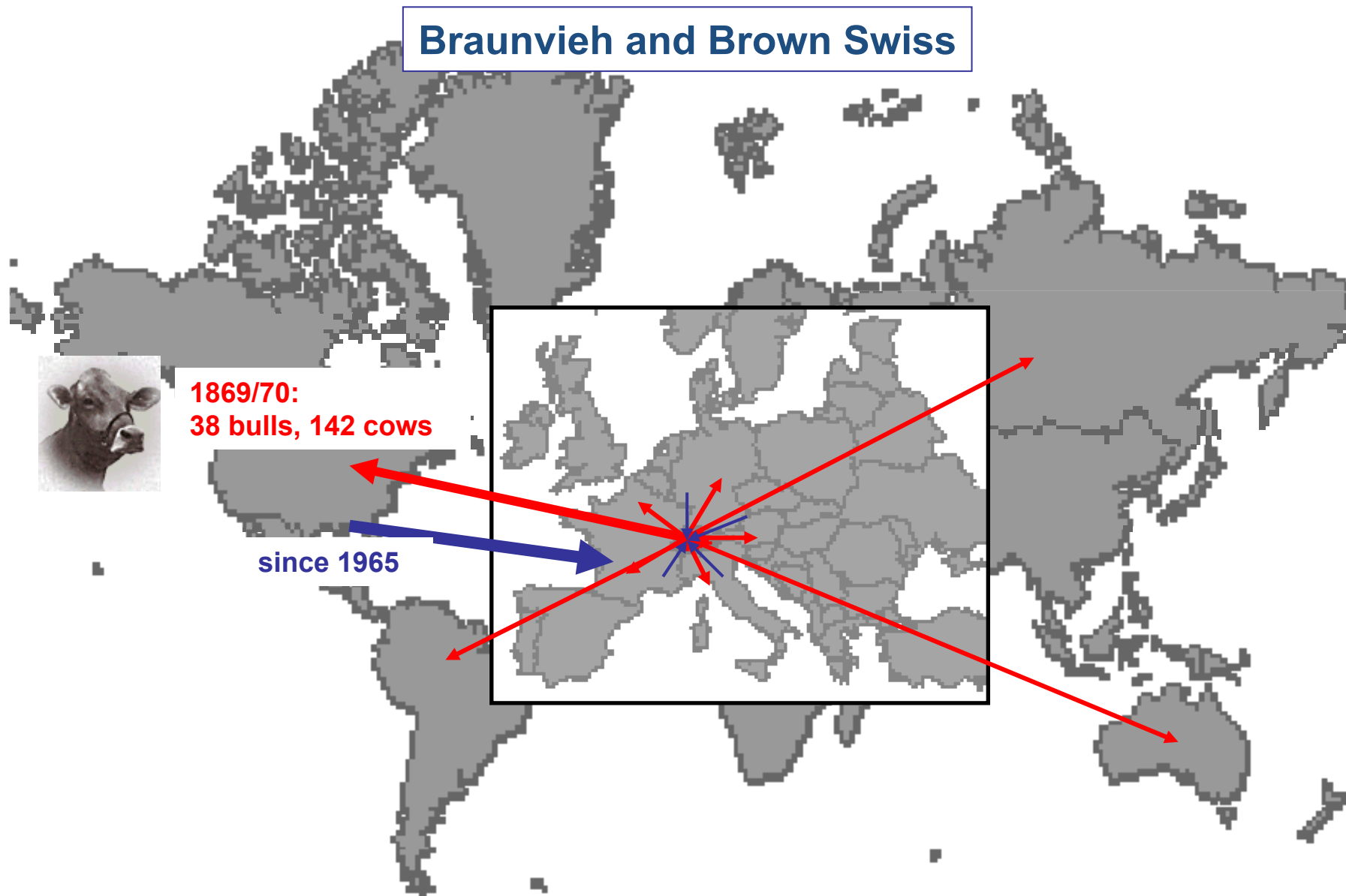
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Braunvieh and Brown Swiss



**1869/70:
38 bulls, 142 cows**

since 1965



Original Swiss Braunvieh



Swiss Braunvieh X
US Brown Swiss

Fleckvieh

Original Simmental Fleckvieh crossed with:

- Montbéliarde and Red Holstein since 1960s

Herdbook Sections Swiss Fleckvieh

Section	Proportion of genes	Colour
SI Simmental	$\geq 87\%$ Simmental	Red
MO Montbéliarde	$\geq 75\%$ Montbéliarde	Red
FT Fleckvieh	14% - 74% Holstein	Red
RH Red Holstein	$\geq 75\%$ Holstein	Red
HF Holstein	$\geq 75\%$ Holstein	Black

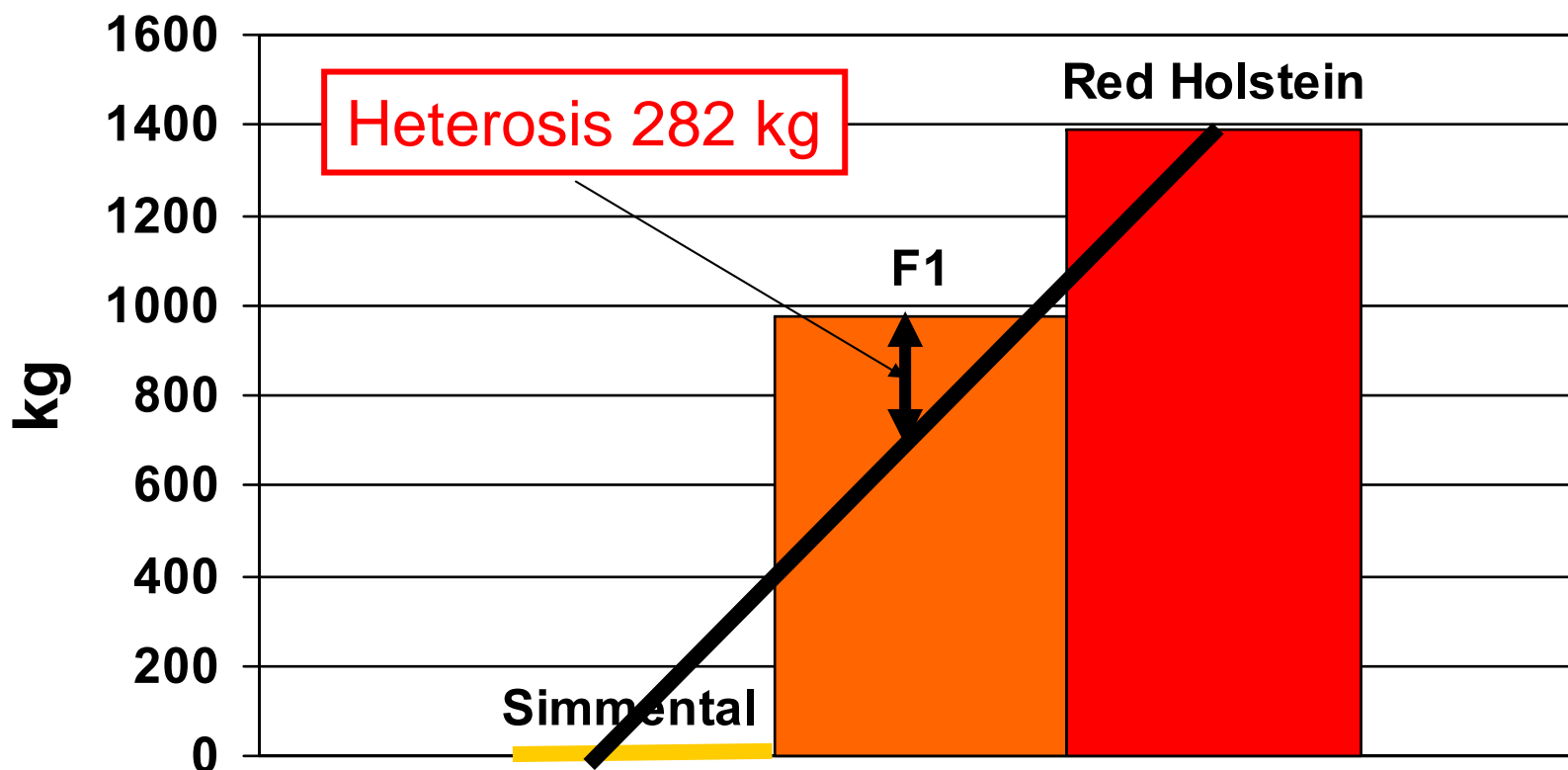


↻ **Simmental**

↑ **Swiss Fleckvieh**

↶ **Red Holstein**

Milk yield of Simmental, Red Holstein and their crosses



Schmidlin 1979

Fleckvieh dual purpose

Land	Jahr	Fleckviehtiere gesamt	Rasse-anteil im Land	HB-Kühe	Fleckvieh-züchter	Dursch. Kuh-bestand
Ungarn	2004	110 000	17	12 056	507	24
Tschechien	2004	604 000	48	170 000	1 177	149
Slowenien	2004	234 000	59	36 202	9 780	4
Slowakei	2004	180 000	30	36 376	212	198
Serbien-M.	2004	867 000	85	43 300	8 660	5
Schweiz FT	2004	180 000	13	70 000	3 500	20
Schweiz SIM	2004	65 000	5	25 100	1 600	16
Österreich	2004	1 720 000	80	251 000	17 700	14
Kroatien	2004	229 000	78	129 161	24 307	5
Italien	2004	135 000	5	42 276	4 180	10
Frankreich MON	2004	700 000	14	175 848	4 441	40
Deutschland	2004	3 590 000	27	660 262	20 505	32

European Association of Fleckvieh Breeders

Fleckvieh Meat

Land	Jahr	Fleckviehtiere gesamt	Rasse-anteil im Land	HB-Kühe	Fleckvieh-züchter	Dursch. Kuh-bestand
Ungarn	2004	15 000	5	3 388	31	109
Slowakei	2004	24 200	6	3 012	174	17
Serbien-M.	2004	225 000	76	14 072	1 789	8
Schweiz SIM	2004	20 000	30	414	38	11
Schweden	2004			2 400	150	16
Österreich	2004			3 646	418	9
Norwegen	2004		3	415		
Italien	2004			3 730	725	5
Irland	2004			3 500	550	6
Großbritannien	2004	6 131			1 032	
Deutschland	2004	120 000	18	10 027	376	27

European Association of Fleckvieh Breeders

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(Swiss Braunvieh as an example, similar development in Fleckvieh and other Western European populations)

Performance recording (Swiss Braunvieh)

Conformation	< 1900 1992	Judging of individual positions Linear type traits
Milk production	1921 1942 1958 1963 1990	First milk recordings (owner sampling) Fat content Integral recording Protein content (1978 all recorded cows) Additional milk constituents (lactose, urea, somatic cells)
Milkability	1963 2004	Milking speed, quarter distribution, strip milk Subjective score
Reproduction	1968 later	Basis: herdbook and insemination data Calculation of days open Additional measures (NRR, days to 1 st insemination)
Calving performance	1970s	Together with recording of births
Health data	2006	Project of Swiss Cattle Breeders

Estimated Breeding Values (Swiss Braunvieh)

1952	Milk production
1981	Reproduction, persistency
1992	Linear type traits
1995	Calving performance
1999	Somatic cells, Milking speed
2000	Productive life
Future	Health traits

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Verbal breeding goals

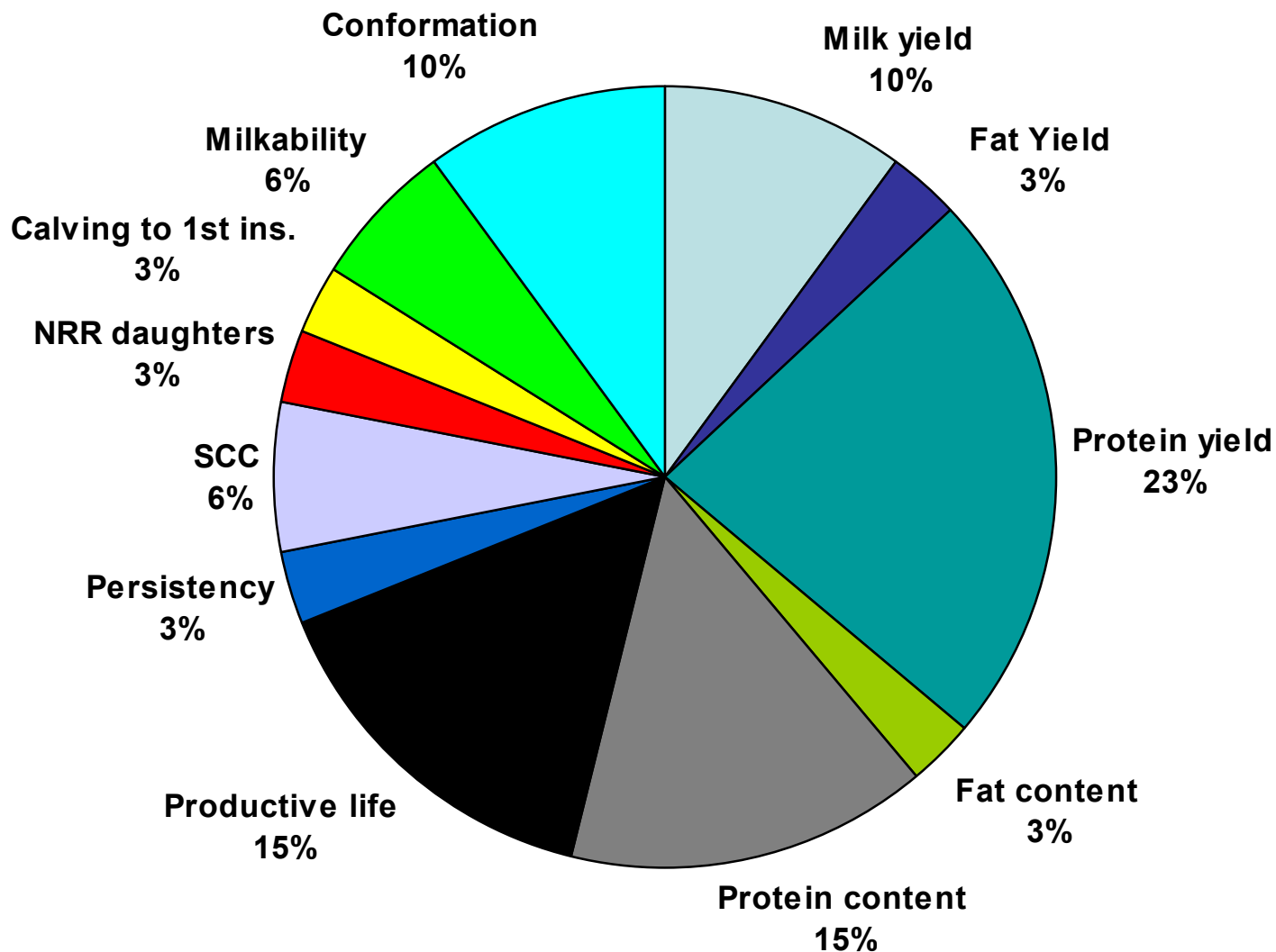
Swiss Braunvieh 1992: Milk, meat
Precocity, Fertility, Longevity
Conformation as basis for
high and persistent production,
consumption of roughage
Milk quality (cheese production)
Carcass and meat quality

Broadly defined breeding goal to accommodate for
different production environments.

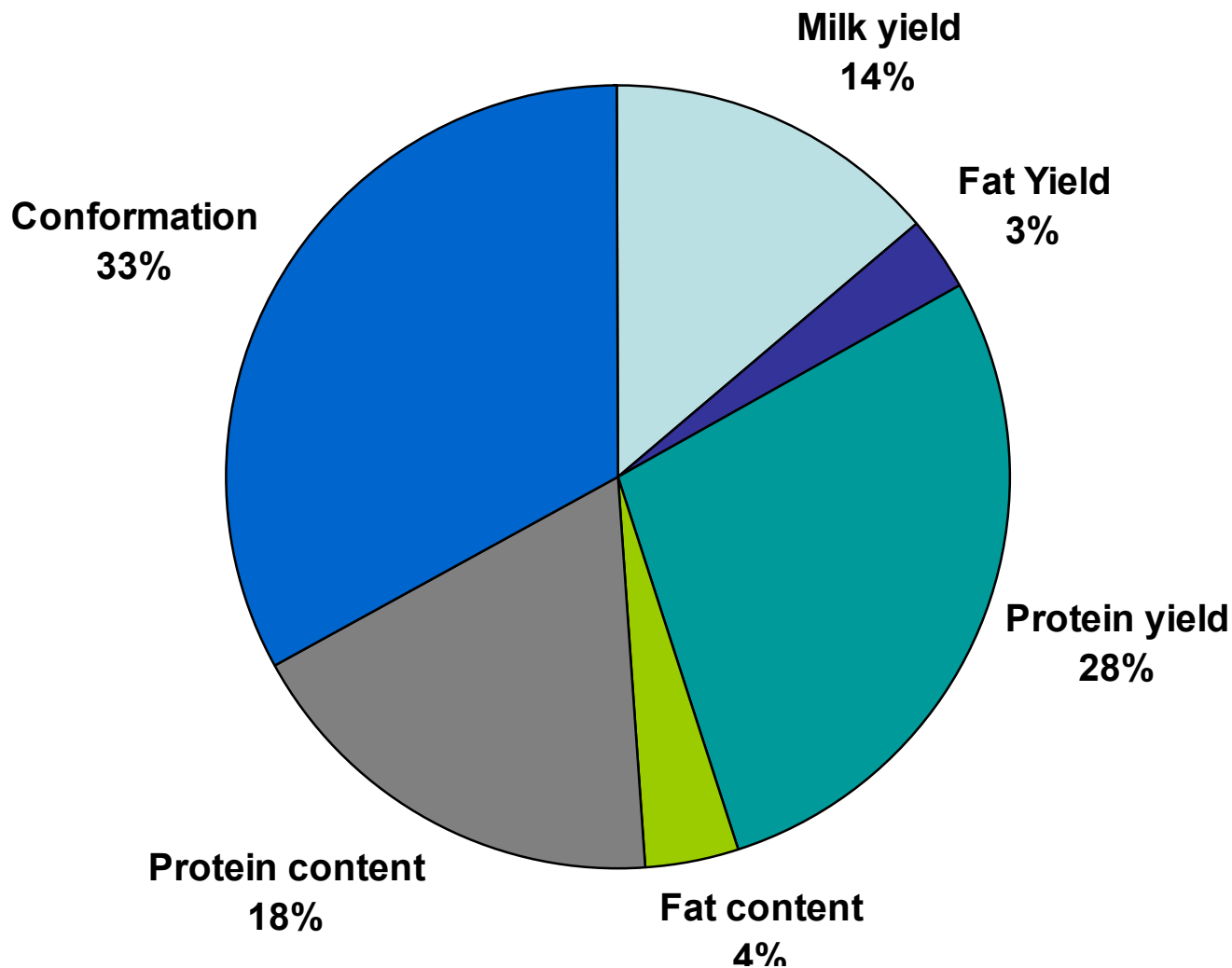
Today's breeding goal: Concrete figures

- **Milk performance (including constituents)**
- **Meat performance (Original Braunvieh)**
- **Functional traits:**
 - **Longevity**
 - **Udder health**
 - **Reproduction**
 - **Milkability**
 - **Calving performance**
- **Morphological traits**

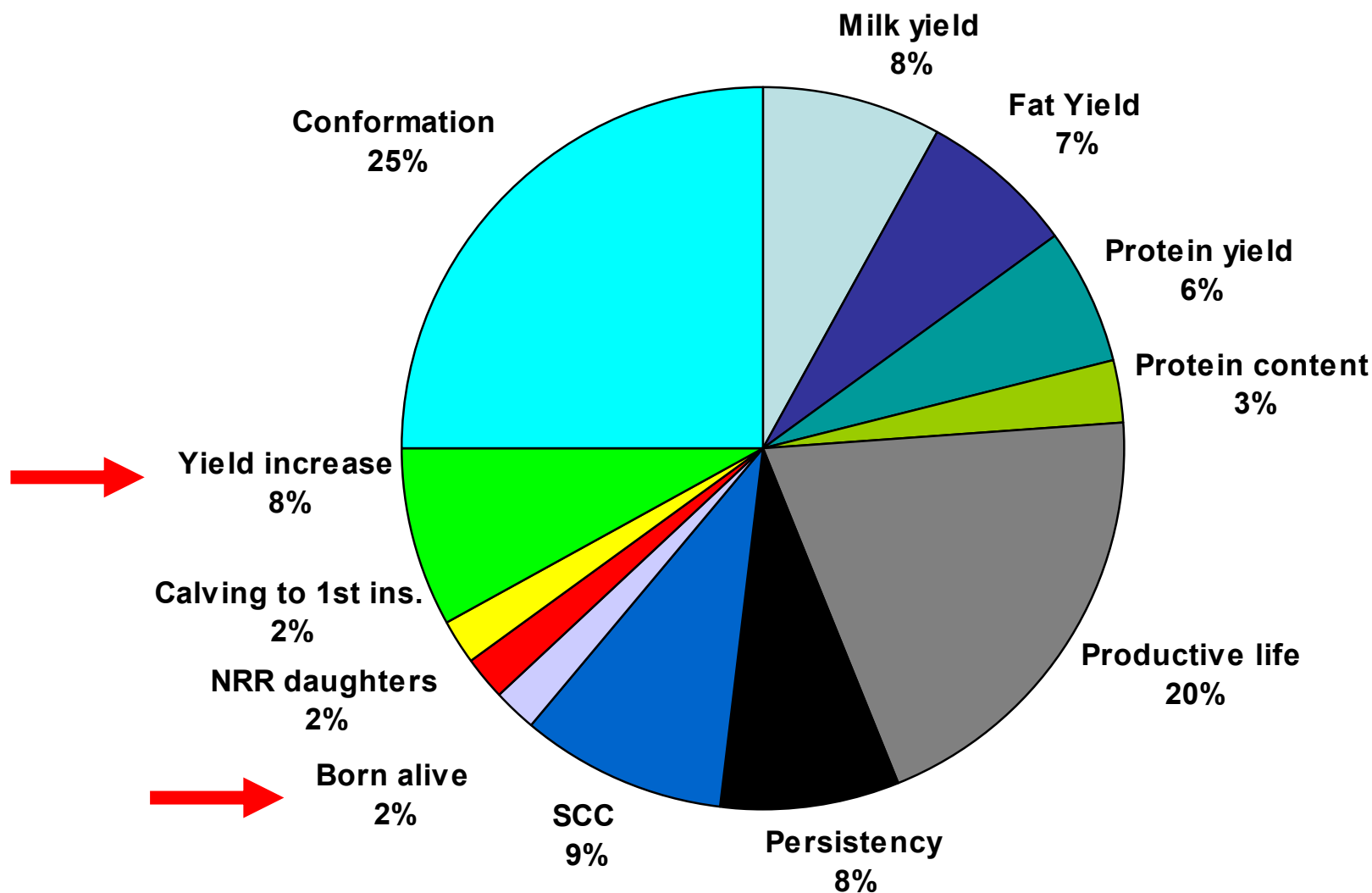
Economic index for bulls (Swiss Braunvieh)



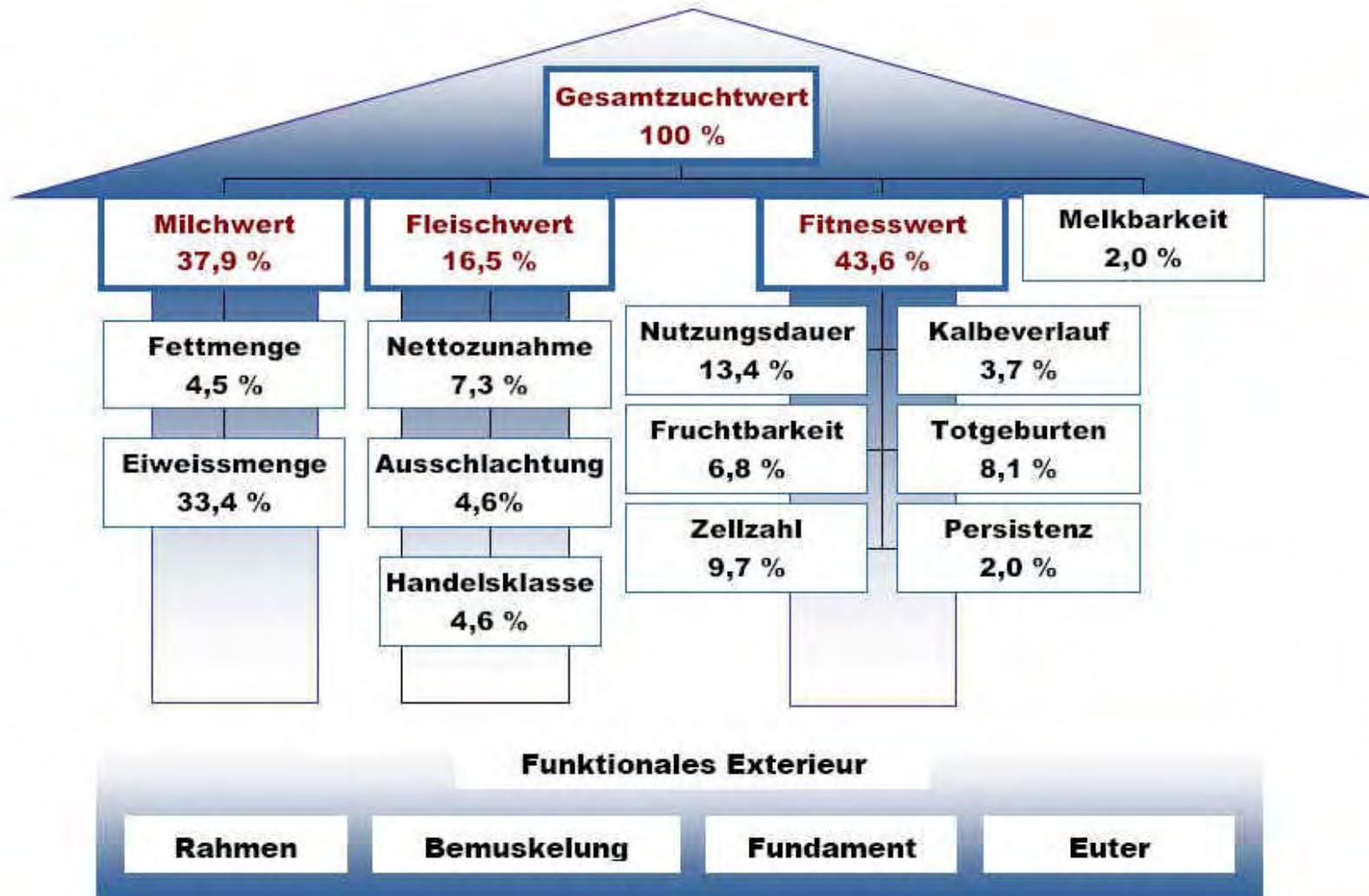
Economic index for cows (Swiss Braunvieh)



Economic index for organic farming (Swiss Braunvieh)



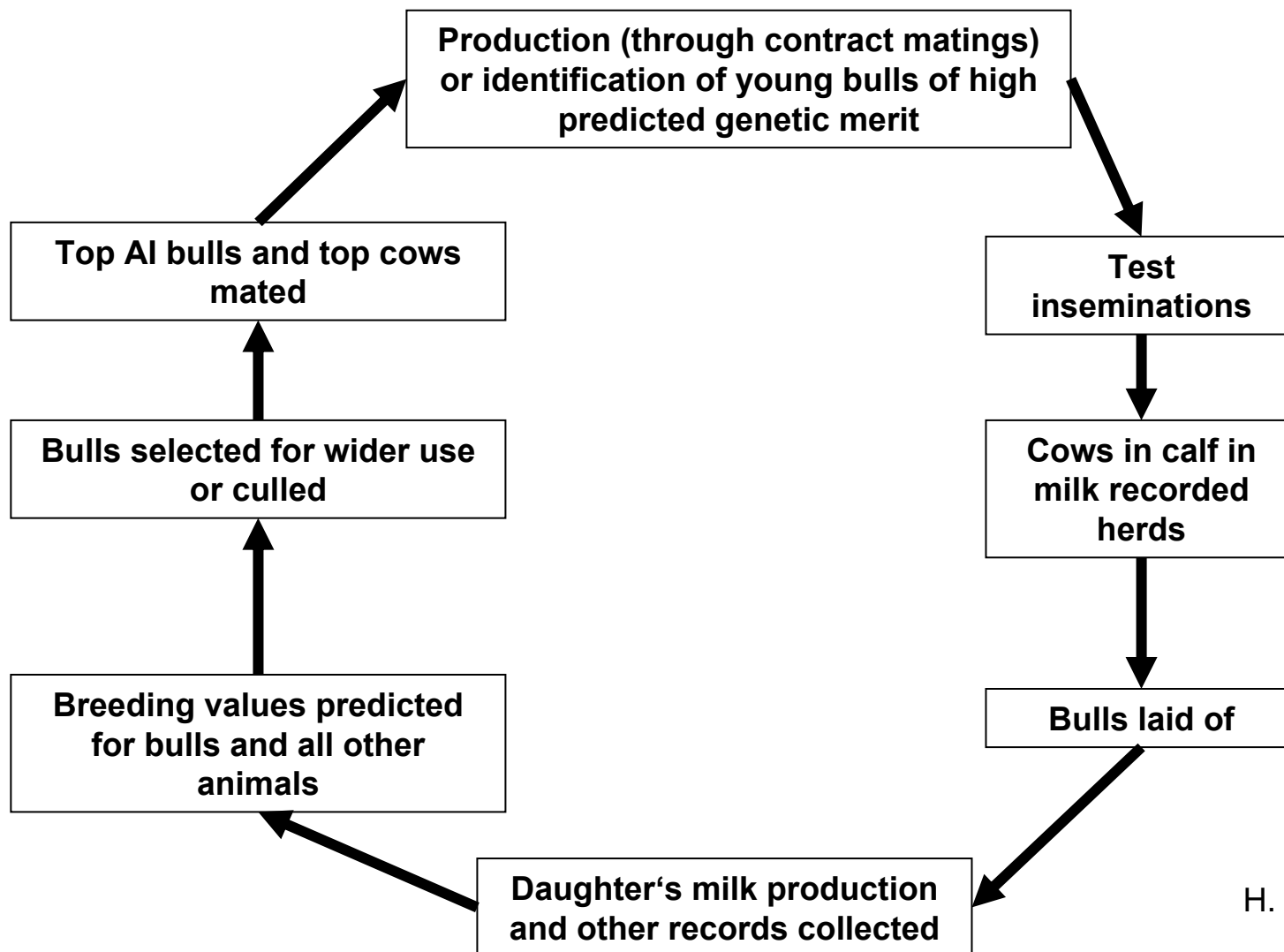
Austrian and German Fleckvieh:



Content

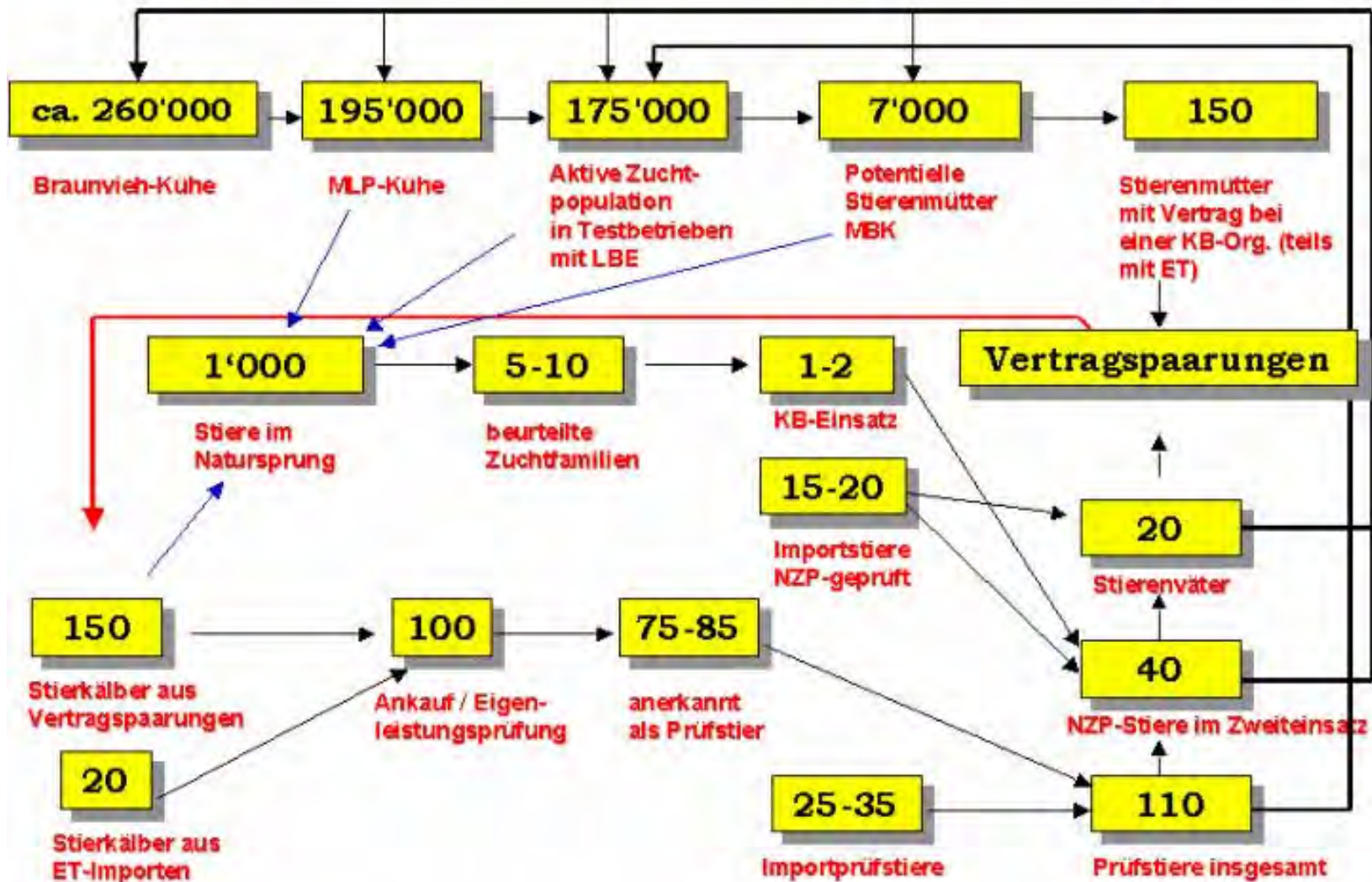
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Progeny Testing in Dairy Cattle



H. Kadarmideen

Zuchtprogramm beim Schweizer Braunvieh (90% künstliche Besamung)



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Measuring genetic diversity

“Ideal population”

- Random mating
- Equal proportion of sexes
- No mutations
- No selection
- No migration

Measuring genetic diversity

Rate of inbreeding

$$\Delta F = \frac{1}{2N} : \quad \text{in ideal population}$$

In livestock populations: polygamy
(no. ♀ >> no. ♂)

J. Anim. Breed. Genet. 2005

Estimates of genetic diversity in the brown cattle population of Switzerland obtained from pedigree information

C. Hagger

Reference population	Braunvieh (BS crossbred)		Original Braunvieh	
	Animals	% Males	Animals	% Males
1992	74 082	3.59	2079	10.39
1993	74 319	3.45	2020	11.58
1994	74 257	3.08	1916	10.80
1995	74 037	2.55	1924	10.40
1996	74 315	1.87	2027	8.63
1997	69 280	2.16	2089	11.15
1998	72 729	3.41	2439	20.91
1999	68 285	3.55	2476	23.30
2000	67 734	3.71	2561	21.12
2001	112 302	38.66	3790	42.37
2002	123 061	47.66	4342	47.03

Measuring genetic diversity

Rate of inbreeding

$$\Delta F = \frac{1}{2N} : \quad \text{in ideal population}$$

In livestock populations: polygamy
(no ♀ >> no ♂)

⇒ ΔF estimated from pedigree information

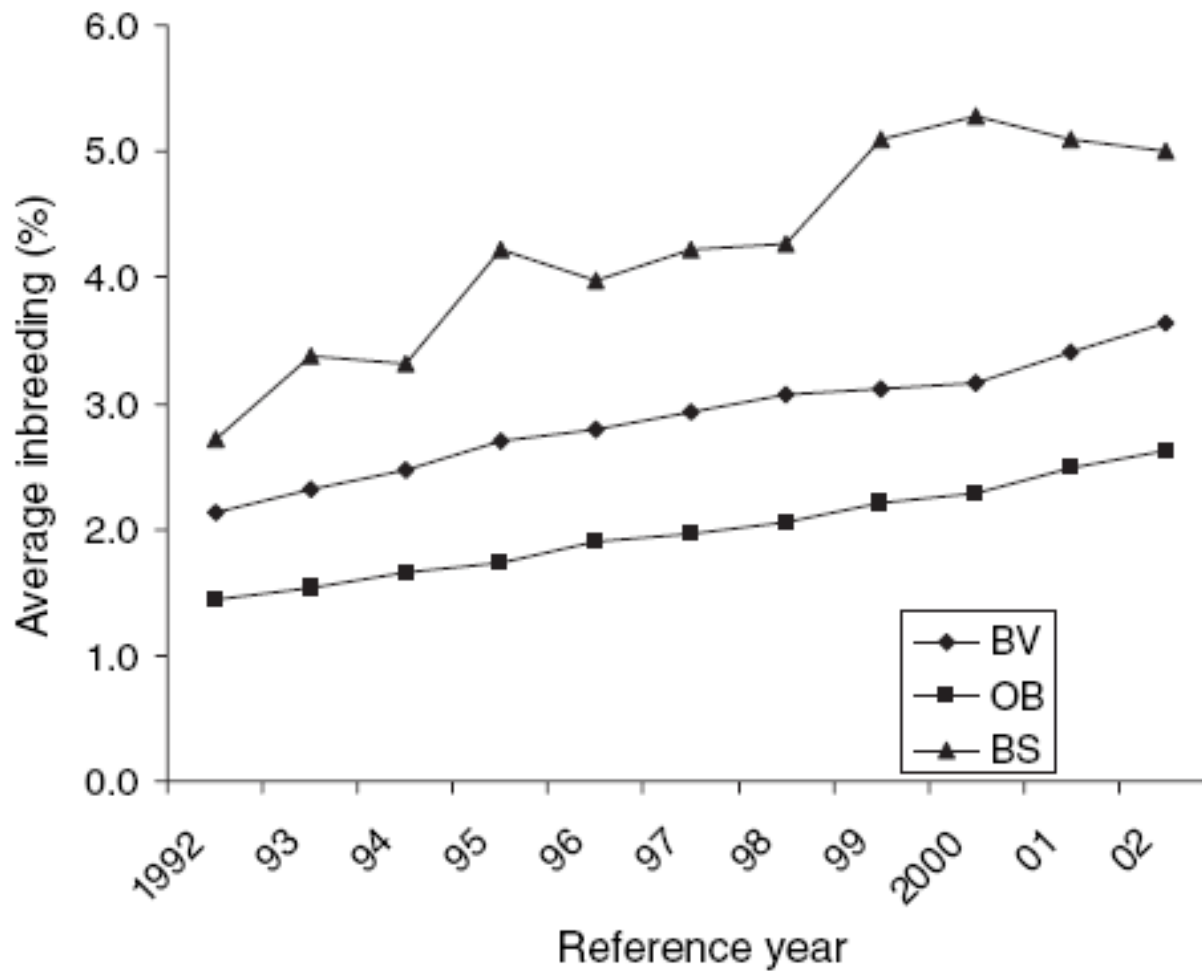


Figure 2 Development of average inbreeding of reference populations.

Measuring genetic diversity

Effective population size N_e :

Number of individuals in an ideal population corresponding to the number of individuals in real populations with unequal proportion of sexes.

$$N_e = \frac{1}{2 \cdot \Delta F}$$

$$N_e = 4 \cdot \frac{n_m \cdot n_w}{n_m + n_w}$$

Measuring genetic diversity

Effective population size (N_e) and rate of inbreeding (ΔF) depending on number of breeding animals (n_m, n_f)

n_m	n_w	N (real)	N_e (effective)	ΔF (in%)
50	50	100	100	0,50
20	80	100	64	0,78
15	85	100	51	0,98
10	90	100	36	1,39
5	95	100	19	2,63
25	25	50	50	1,00
50	1000	1050	190,5	0,26
30	1000	1030	116,5	0,43
20	1000	1020	78,4	0,64
10	1000	1010	39,6	1,26
5	1000	1005	19,9	2,51

Effective population size (N_e) for Braunvieh (BV, Brown Swiss crossbreds) and Original Braunvieh (OB)

Reference population	BV	OB
1992	100.4	82.2
1993	106.4	80.1
1994	137.0	82.3
1995	108.3	83.0
1996	81.6	74.7
1997	88.1	90.6
1998	449.5	98.8
1999	180.6	87.6
2000	117.6	83.0
2001	126.2	78.3
2002	113.8	73.0

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Benefits from Interbull services

- **Availability of AI bulls from many countries through comparable EBVs**
 - **Breed stays competitive**
 - **Breed stays genetically diverse**
- ⇒ **Sustainability maintained**

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Conclusions and Trends

- **Braunvieh, Fleckvieh:**
Breeding goals always included functional traits
- **Economic indices:**

Production traits	~ 50 %
Functional traits	~ 30 – 40 %
Conformation	~ 10 – 20 %
- **More weight on functional traits, including health traits**
- **Genetic diversity: $N_e \sim 100$, inbreeding trend acceptable**
- **Interbull services enable competitiveness, genetic diversity and sustainability**