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Comparison of different methods to validate a dataset with producer-recorded health events

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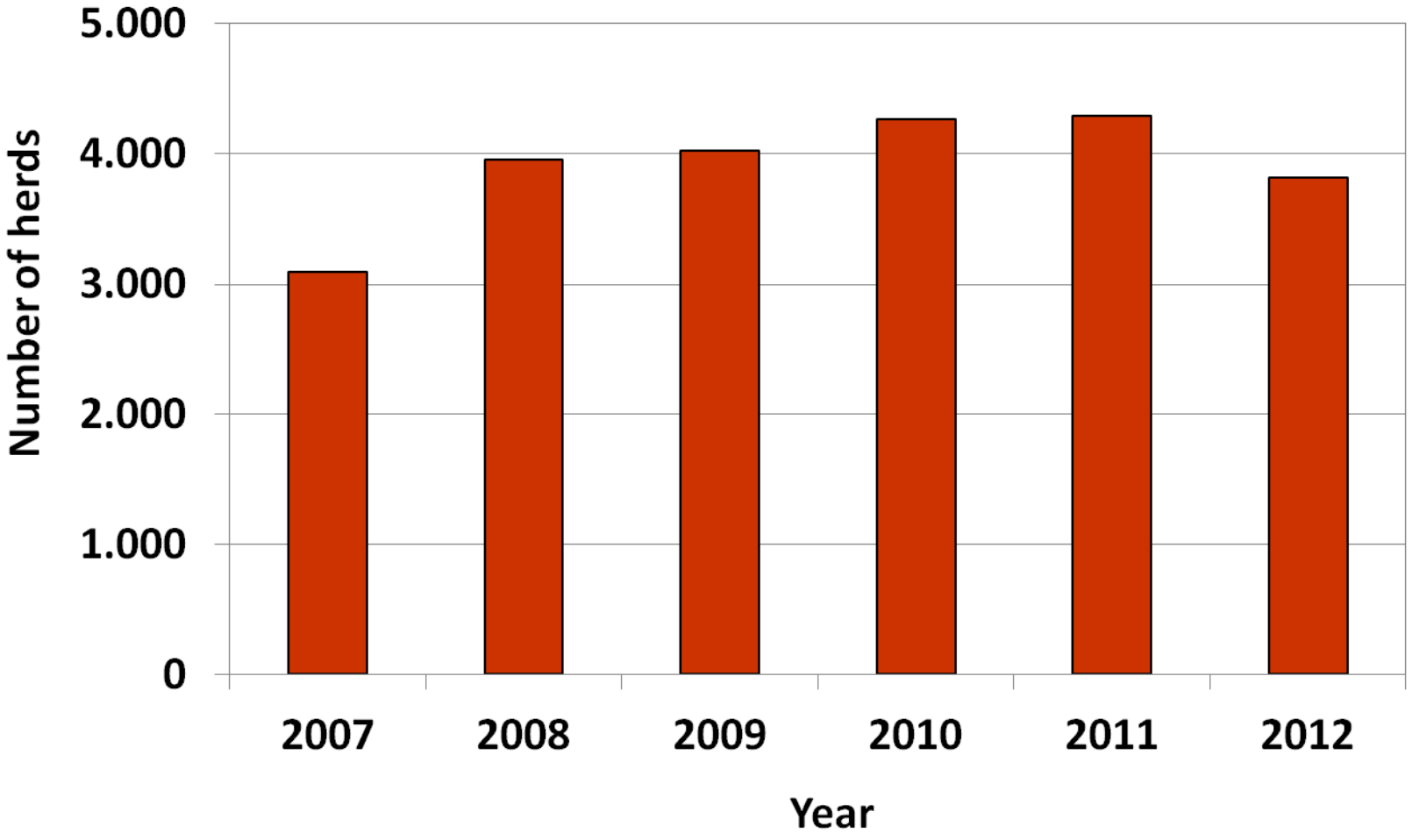
Canadian health recording system

- Health recording system since April 2007
- Recording done by producers on a voluntary basis
- Eight diseases are recorded: mastitis, displaced abomasum, ketosis, milk fever, retained placenta, metritis, cystic ovaries and lameness
- Overall goal is to develop a genetic evaluation for resistance to mastitis and to other diseases in Canadian dairy cattle

Number of herds recording health data



Participation:
40% of all milk recorded herds

Data quality

- To obtain reliable and accurate evaluations, recording of disease cases should be as complete as possible on all participating farms
- However, data quality can vary among farms and even for a given farm over time
- Under-reporting of diseases in general, and for specific disease is possible

Data validation

Country	Data validation
Norway	Mandatory disease recording system – assumed that all herds report complete health data
Sweden	Mandatory disease recording system – assumed that all herds report complete health data
Finland	At least 1 veterinary diagnose per herd and year
Denmark	▪ Number of treatments is greater than or equal to 0.3 per calving in the period from calving to 4 or 9 months after calving ▪ Last 4 months at least 7 calvings ▪ Last 9 months at least 10 calvings ▪ In the 9-month period, it is not allowed to be a 3 month period after birth, where there is no reported disease diagnosis in the herd
Austria	▪ Farms with a minimum average of 0.1 first diagnoses per cow and year ▪ Continuous submission of health data by veterinarians or performance recording technicians

Objective

- Analysis of data quality in the Canadian health recording system
- Investigate the impact of 5 data validation methods on genetic evaluation for mastitis resistance

Data validation
Herds with reliable recording

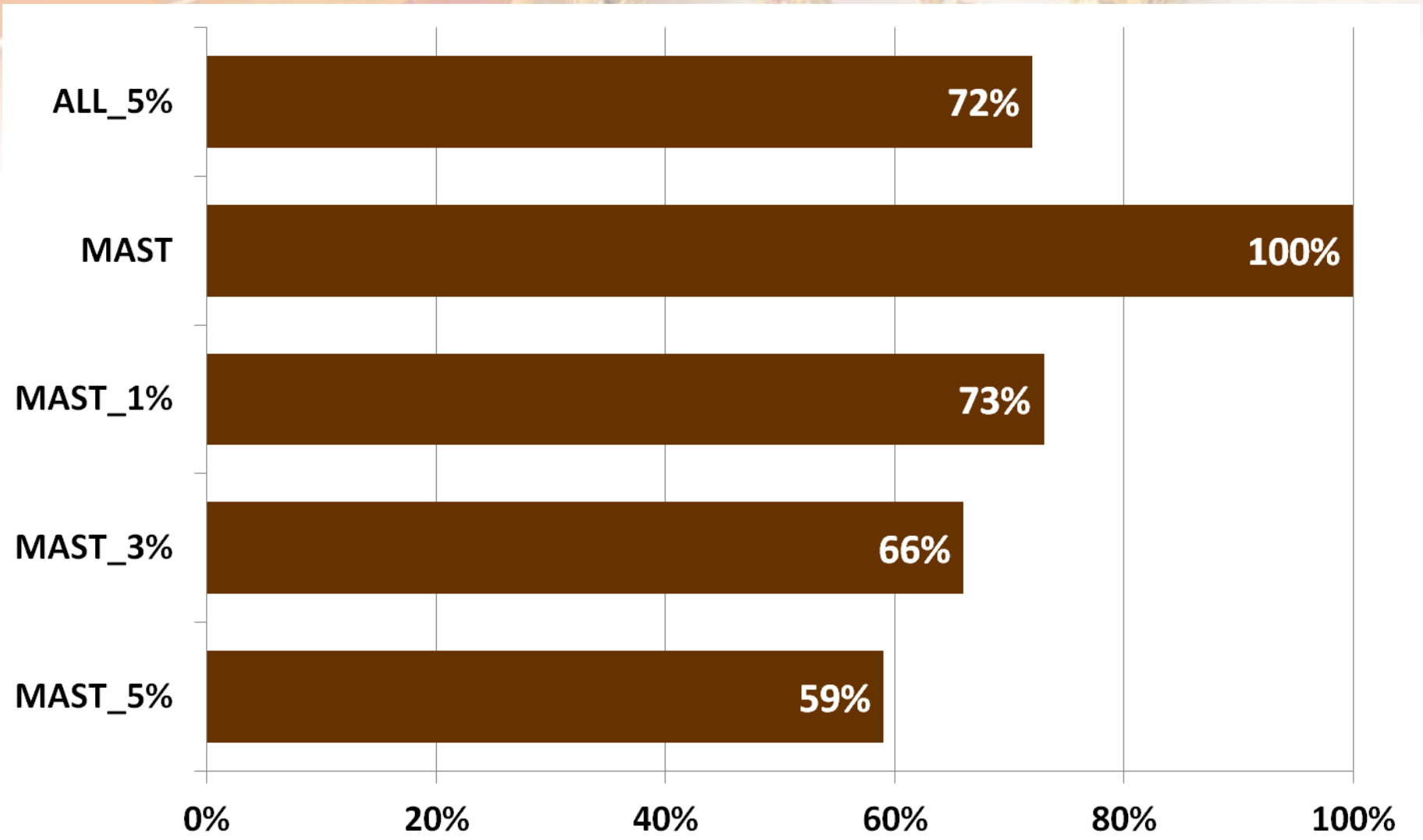
- At least 1 recorded mastitis case + minimum mastitis frequency of 5% per herd and year (MAST_5%)
- At least 1 recorded mastitis case + minimum mastitis frequency of 3% per herd and year (MAST_3%)
- At least 1 recorded mastitis case + minimum mastitis frequency of 1% per herd and year (MAST_1%)
- At least 1 recorded mastitis case (MAST)
- At least 1 recorded disease case (any disease) + minimum disease frequency of 5% per herd and year (ALL_5%)

Genetic analysis - Traits and models

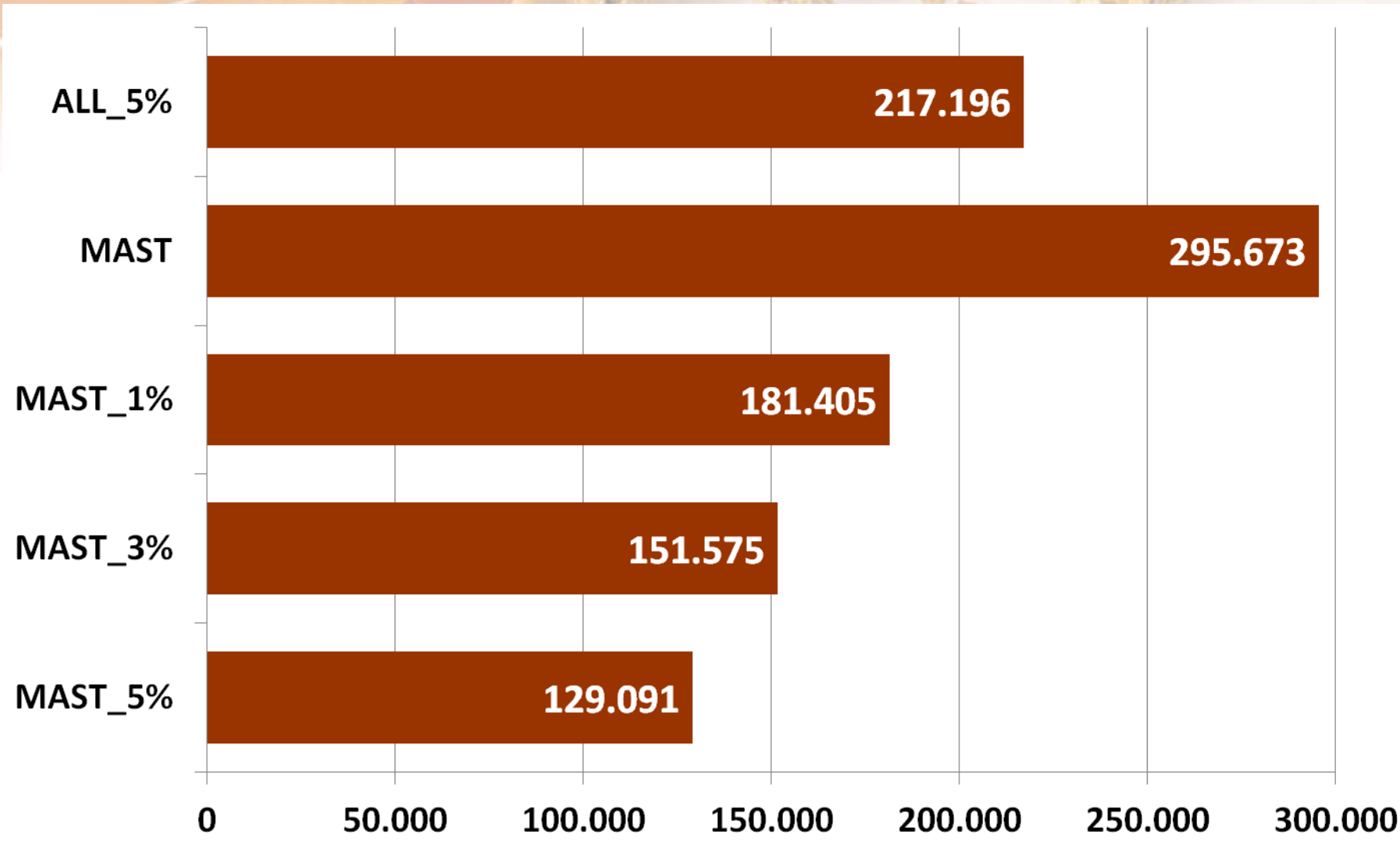
- First lactation Holstein cows
- Traits
  - Mastitis

    Binary trait, scored as 1 or 0, based on whether or not the cow had at least 1 mastitis case within 305 days after calving
  - Lactation mean SCS
- Models
  - Univariate and bivariate linear sire models

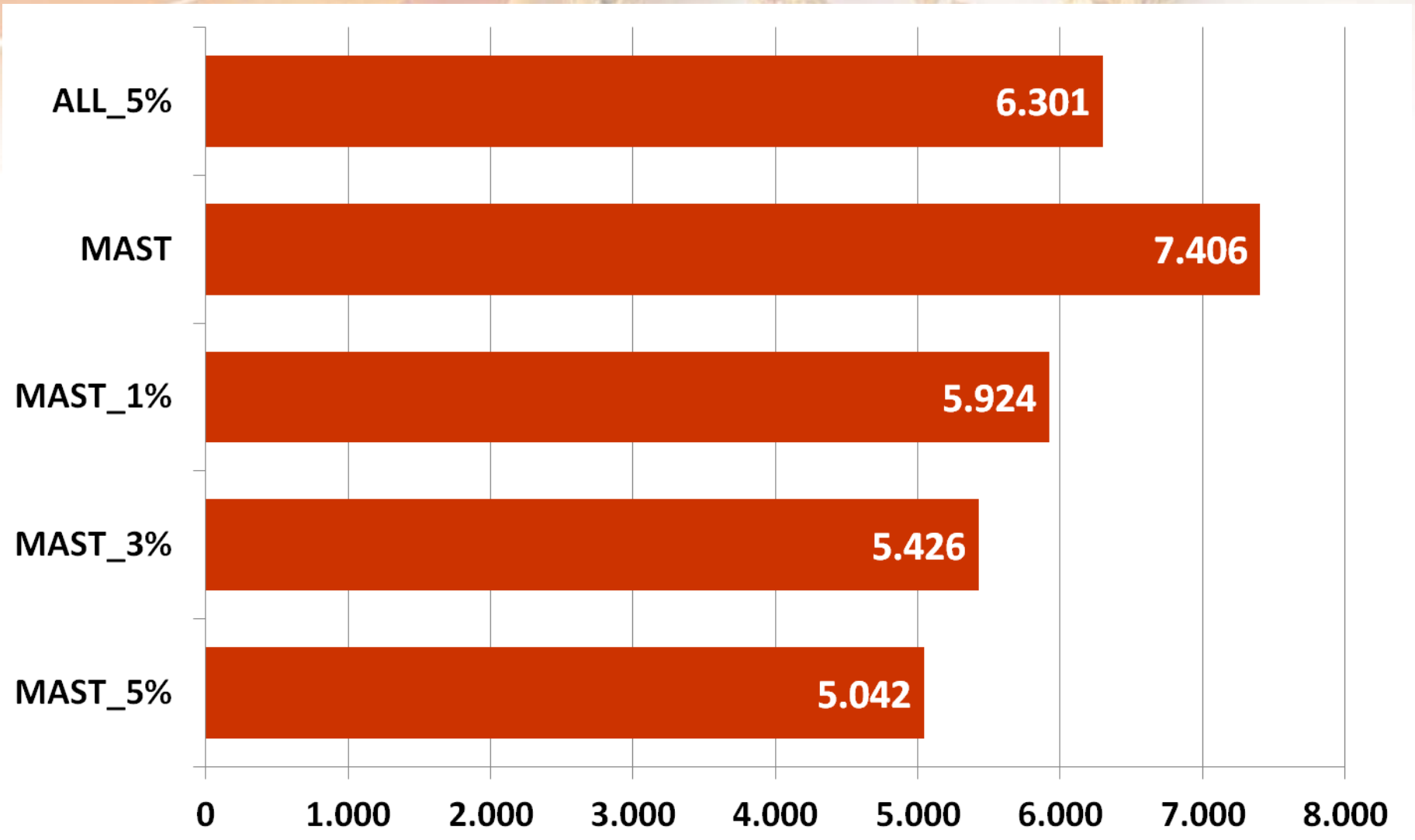
Percentage of usable herds by editing criteria



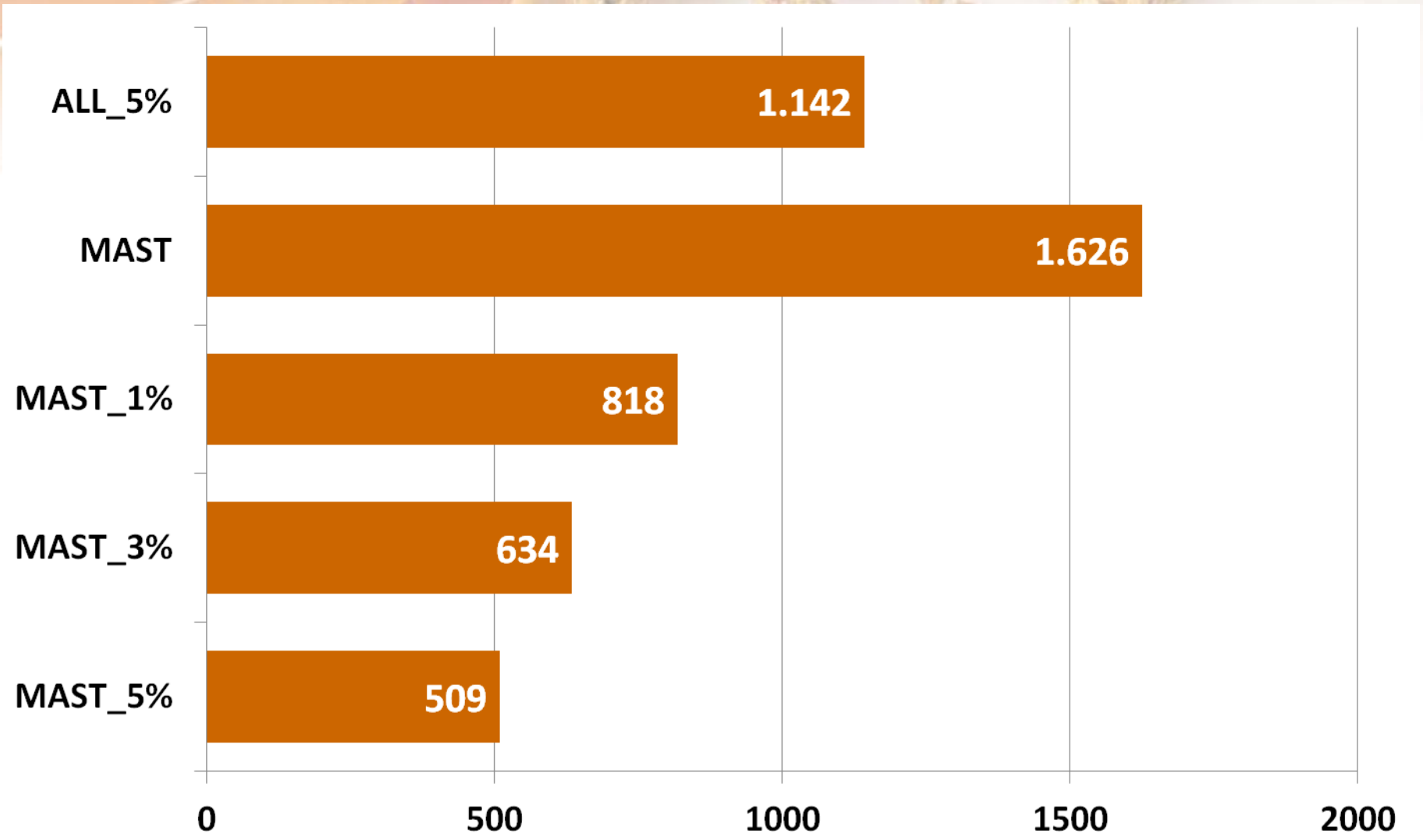
Number of records by editing criteria



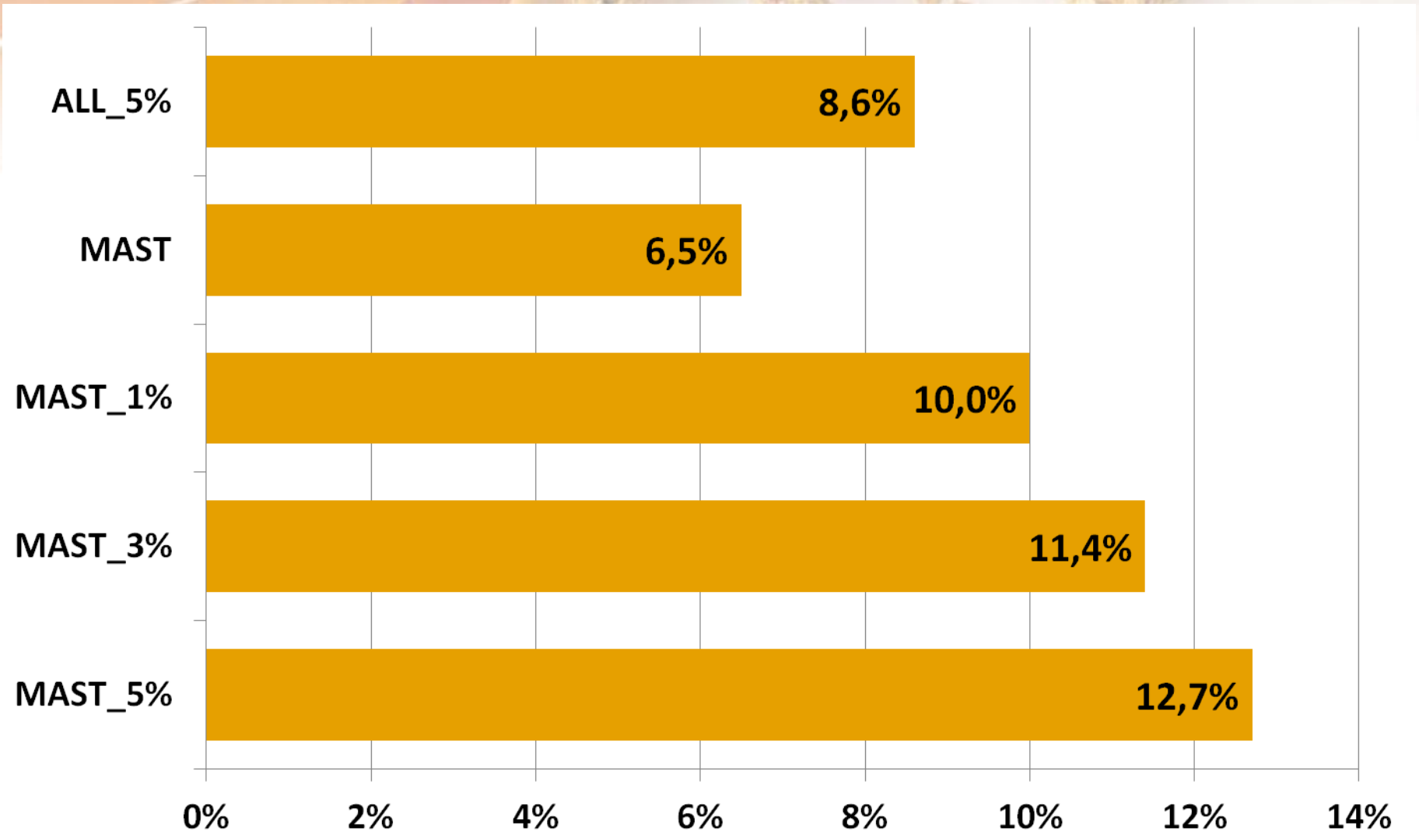
Number of sires with at least 1 daughter by editing criteria



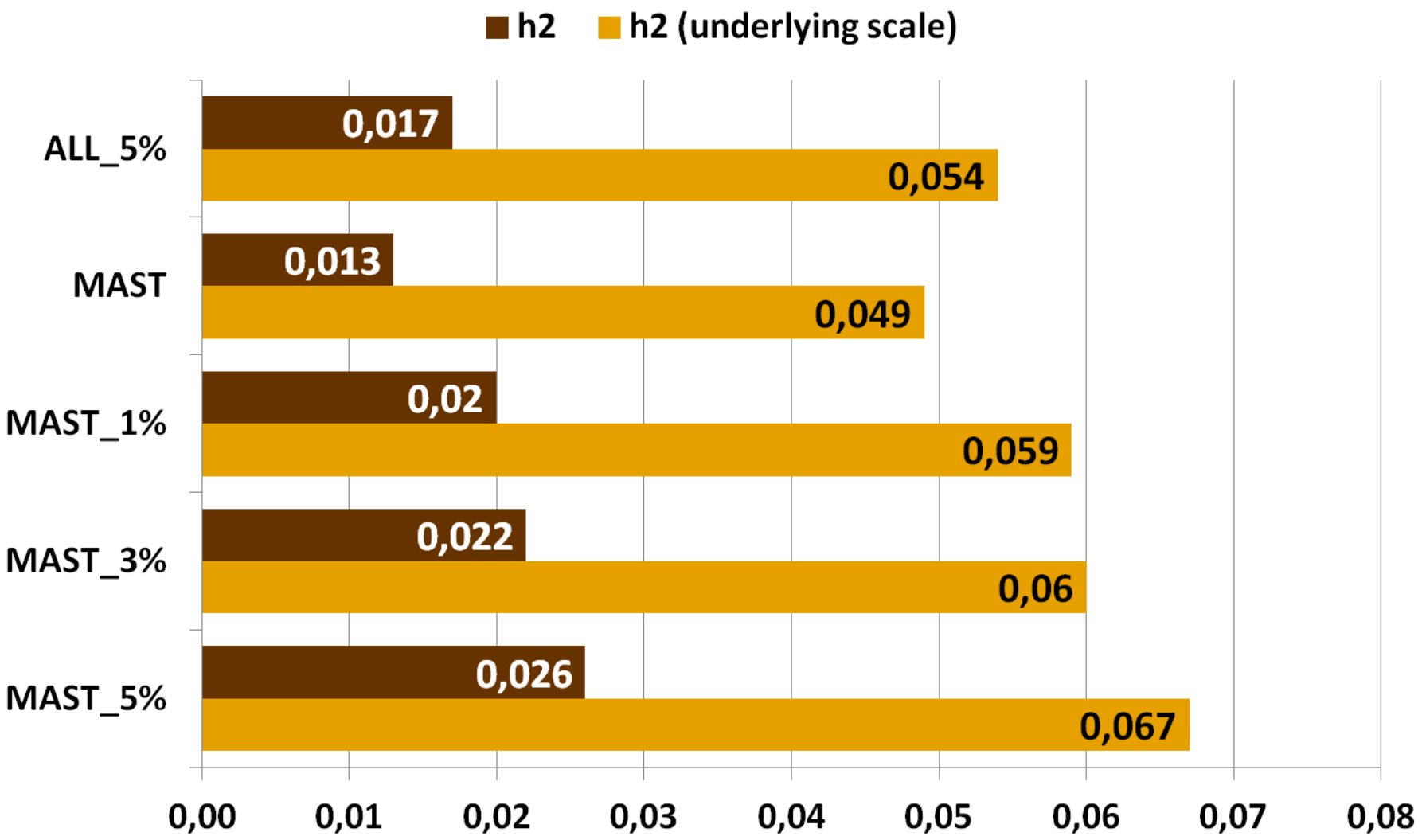
Number of sires with at least 30 daughters by editing criteria



Frequency of mastitis by editing criteria



Heritability of mastitis by editing criteria



Heritability estimates transformed to the underlying scale using formula of Dempster and Lerner (1950).

SCS parameters and genetic correlations with mastitis by editing criteria

	Heritability, LSCS	Genetic correlation
MAST_5%	0.123	0.69
MAST_3%	0.125	0.66
MAST_1%	0.123	0.65
MAST	0.122	0.66
ALL_5%	0.124	0.68

Correlations between sire EBV for mastitis resistance

Sires with at least 30 daughters in all data sets (n = 509)

Data validation method	MAST_3%	MAST_1%	MAST	ALL_5%
MAST_5%	0.986	0.976	0.957	0.962
MAST_3%		0.990	0.972	0.973
MAST_1%			0.984	0.976
MAST				0.973

Number of top 100 bulls in common with data validation method MAST_5%

	MAST_5%
MAST_3%	91
MAST_1%	90
MAST	86
ALL_5%	85

Conclusions

- Data validation is an important part of analysis of producer-recorded health data
- Less stringent data validation led to a lower mastitis frequency, indicating a likely level of underreporting in the Canadian health recording system
- Genetic evaluations stay similar across the investigated data validation methods
- Future work is necessary to increase data quality in the Canadian health recording system

Implementation of a routine genetic evaluation for mastitis resistance

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Multiple-trait animal model

- **First parities vs. later parities**
  - **Mastitis: scored as 0 (no case) or 1 (at least one case) in the period from calving to 150 days after calving**
  - **Mean SCS in early lactation**
  - **Standard deviation of SCS in early lactation**
  - **At least one SCC TD record over 500k in early lactation**
- **First parity cows**
  - **Udder depth**
  - **Fore udder attachment**
  - **Body condition score**

Model for mastitis and SCS traits

$$y = HP + YSP + ASP + hyp + a + pe + e$$

where the fixed effects are:

HP: herd – parity

YSP : year – season – parity

ASP: age – season – parity

and the random effects are:

Hyp: herd – year – parity

a: animal additive genetic

pe: permanent environmental

e: residuals

Model for type traits

$$y = HRC + AST + a + pe + e$$

where the fixed effects are:

HRC: herd – round – classifier

AST: age – season – time of classification

and the random effects are:

a: animal additive genetic

pe: permanent environmental

e: residuals

Heritabilities

Lactation	Trait	h^2
First	Mastitis	0.028
	SCS_{150}	0.131
	SCS_{SD}	0.024
	SCS_{500}	0.041
Later	Mastitis	0.047
	SCS_{150}	0.174
	SCS_{SD}	0.026
	SCS_{500}	0.094
Udder depth		0.499
Fore udder attachment		0.333
Body condition score		0.264

Genetic correlations

Lactation/Trait		First				Later						
		MAST	SCS_{150}	SCS_{SD}	SCS_{500}	MAST	SCS_{150}	SCS_{SD}	SCS_{500}	UD	FUA	BCS
First	MAST		0.55	0.51	0.72							
	SCS_{150}			0.15	0.78							
	SCS_{SD}				0.52							
	SCS_{500}											
Later	MAST						0.74	0.69	0.78			
	SCS_{150}							0.64	0.91			
	SCS_{SD}								0.74			
	SCS_{500}											
	UD											
	FUA											
	BCS											

Within parity:
Higher correlations in later parities

Genetic correlations

Lactation/Trait		First				Later						
		MAST	SCS_{150}	SCS_{SD}	SCS_{500}	MAST	SCS_{150}	SCS_{SD}	SCS_{500}	UD	FUA	BCS
First	MAST					0.59	0.54	0.50	0.59			
	SCS_{150}					0.55	0.76	0.45	0.69			
	SCS_{SD}					0.45	0.29	0.60	0.43			
	SCS_{500}					0.65	0.74	0.63	0.76			
Later	MAST											
	SCS_{150}											
	SCS_{SD}											
	SCS_{500}											
	UD											
	FUA											
	BCS											

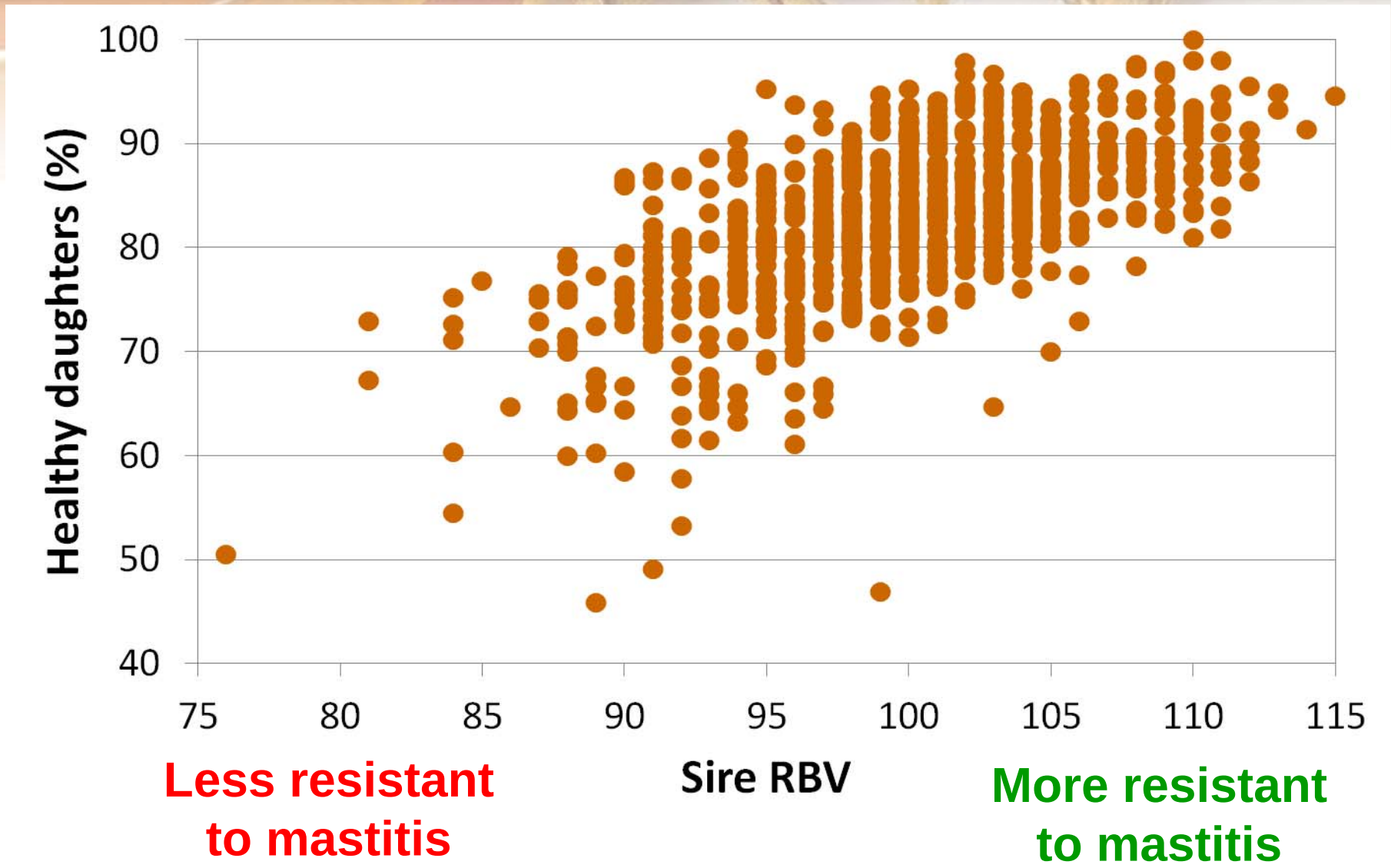
Among parity:
Moderate correlations within trait

Genetic correlations

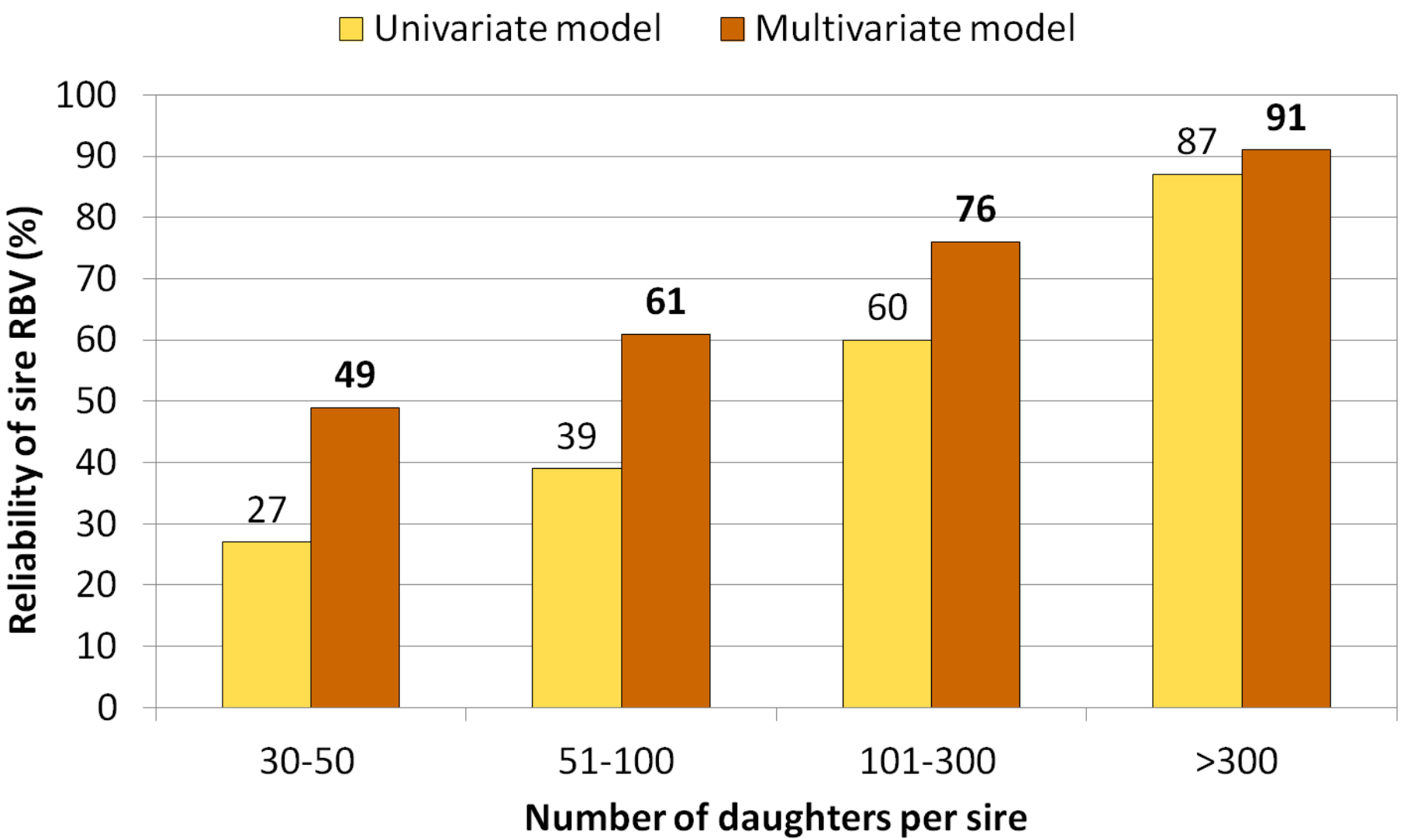
Lactation/Trait		First				Later				UD	FUA	BCS
		MAST	SCS_{150}	SCS_{SD}	SCS_{500}	MAST	SCS_{150}	SCS_{SD}	SCS_{500}			
First	MAST									-0.52	-0.46	-0.34
	SCS_{150}									-0.32	-0.27	-0.29
	SCS_{SD}									-0.44	-0.23	-0.15
	SCS_{500}									-0.50	-0.36	-0.32
Later	MAST									-0.27	-0.09	-0.23
	SCS_{150}									-0.26	-0.08	-0.27
	SCS_{SD}									-0.30	-0.06	-0.12
	SCS_{500}									-0.28	-0.11	-0.31
	UD											
	FUA											
	BCS											

Between mastitis/SCS and type traits:
Higher correlations with 1st parity
(not so different for BCS)

% of healthy daughters according to the RBV for mastitis resistance (N=935)



Reliability of sire RBV for Mastitis Resistance



Next step

- Test run in August with genomic evaluations and sent to Interbull September test run
- Interim releases in the fall for bull owners
- Official release in December 2013, expressed as Relative Breeding Value

10th World Congress on Genetics Applied to Livestock Production

Vancouver, BC, Canada
August 17-22, 2014

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