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PostDoc

Nordic Genetic Evaluation of Feed Efficiency – Updated Model for Saved Feed in Nordic Dairy Cattle Breeds

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History of NAV Saved Feed

Challenge observed in RFI precorrection step

Saved Feed = Maintenance + Metabolic efficiency

2019

Genetic Evaluation for Maintenance – Towards Genomic Breeding Values for Saved Feed in Nordic Dairy Cattle

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2021

Genomic prediction of residual feed intake in the Nordic breeds using data from research herds and 3D cameras in commercial herds

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GEBVs published for all three breeds and included in NTM since 2020

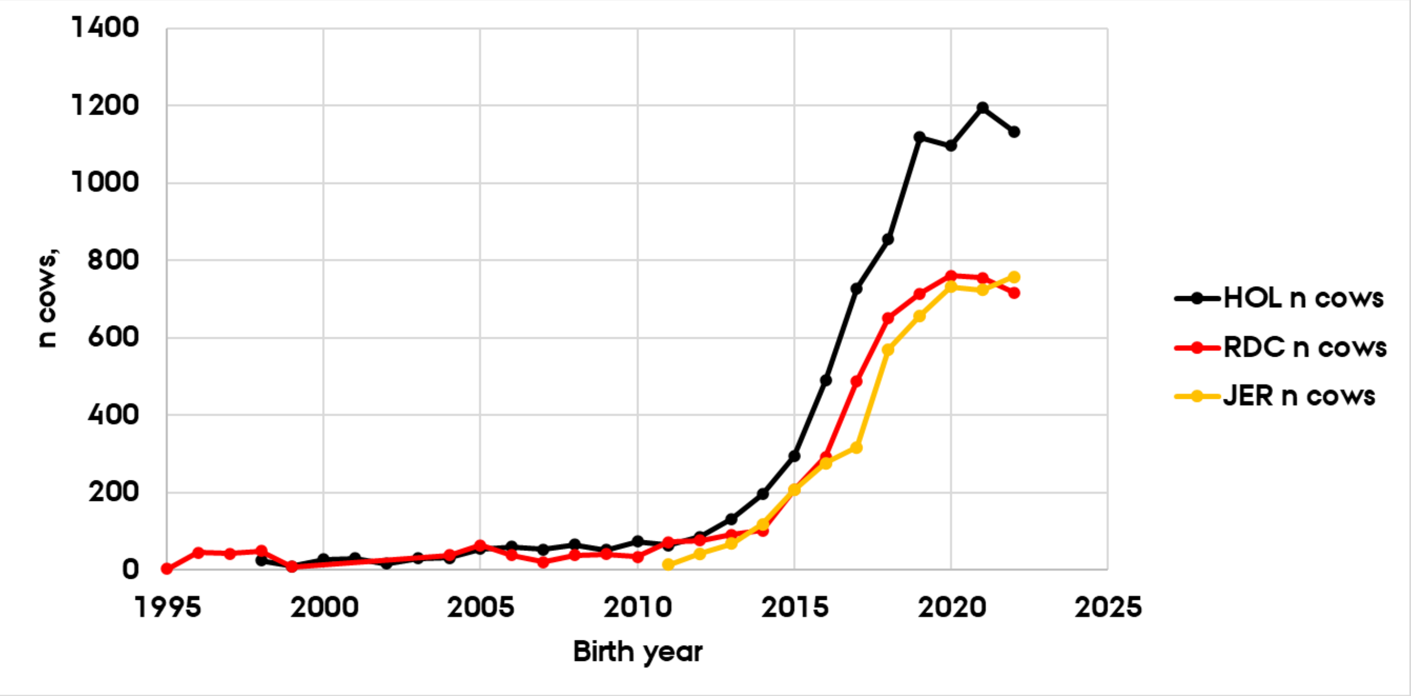
Feed Intake Measurements

CFIT, VikingGenetics (HOL, JER, RDC)

- Milk production measured monthly at test-days

AU-Foulum, research center in Denmark (HOL)

Luke, Finland (RDC)



Feed Intake Measurements

CFIT, VikingGenetics (HOL, JER, RDC)

- Milk production measured monthly at test-days

AU-Foulum, research center in Denmark (528 genotyped HOL)

Luke, Finland (356 genotyped RDC)

Breed	N weekly records DMI	ECM	n cows (genotyped)
HOL	361,412	202,360	8,030 (5,104)
RDC	233,867	108,255	5,377 (3,828)
JER	146,215	84,486	4,541 (3,040)

Cattle Feed InTake system (CFIT)

3D cameras identifies/measures:

- ID of cows
- Body weight
- Feed intake

Combined with production data from official milk recording

Old NAV model for Saved Feed

Maintenance: BW measurements + indicator traits (STA, BD, CW)

Metabolic efficiency -> Residual Feed Intake:

1. Precorrection with Least Square: $DMI = X\beta + ECM + BW + \Delta BW + \varepsilon$
2. Genetic evaluation RFI: $\varepsilon = HYS + YS_{lacp} + \mathbf{a} + pe + e$

Challenged by solving fixed effects, handling missing records & provided non-meaningful regression coefficients

Genetic Saved Feed has been proposed for one-step calculation

Khanal et al. (2022) and Abdalla et al. (2024)

New NAV model for Saved Feed

GEBVs estimated with single-trait multi-parity random regression models

All traits divided into 2 parity groups: Primi- and Multiparous (2nd to 5th)

One-step Saved Feed has no direct phenotypes -> based on:

- GEBV_{DMI}:14 to 280 days in lactation
- GEBV_{ECM}:14 to 280 days in lactation
- $\text{GEBV}_{\Delta\text{BW}}$: diff. from 30 to 280 days in lactation (derived from BW model)

Random regression model effects

Bivariate models: First and later parities for DMI, ECM, & BW:

Model effects	
Age at first calving (only primiparous)	Fixed
Parity (only multiparous)	Fixed
Lactation curve (5th order Legendre Polynomial), for each herd	Fixed
Calving herd x calving year x calving season	Fixed
Additive Genetic effect (1st order)	Random
Permanent Environmental within parity effect (2nd order)	Random
Permanent Environmental effect across parities (only multiparous)	Random
Residual	Random

Heritabilities and genetic correlations

(Co)variance components estimated with AI-REML in DMU (PBLUP)

- For RDC, genetic parameters from HOL were applied
- Used for single-step evaluation of Saved Feed in the MiX99 software

Lactation-wise heritabilities:

	DMI		ECM		BW	
$\text{HOL}_{\text{primi}}$	0.43		0.50		0.52	
$\text{HOL}_{\text{multi}}$	0.90	0.49	0.89	0.48	0.95	0.58

	DMI		ECM		BW	
$\text{JER}_{\text{primi}}$	0.22		0.46		0.46	
$\text{JER}_{\text{multi}}$	0.82	0.50	0.94	0.61	0.90	0.61

NAV

New Saved Feed index

One-step Saved Feed (Regression coefficients with input from feeding norms):

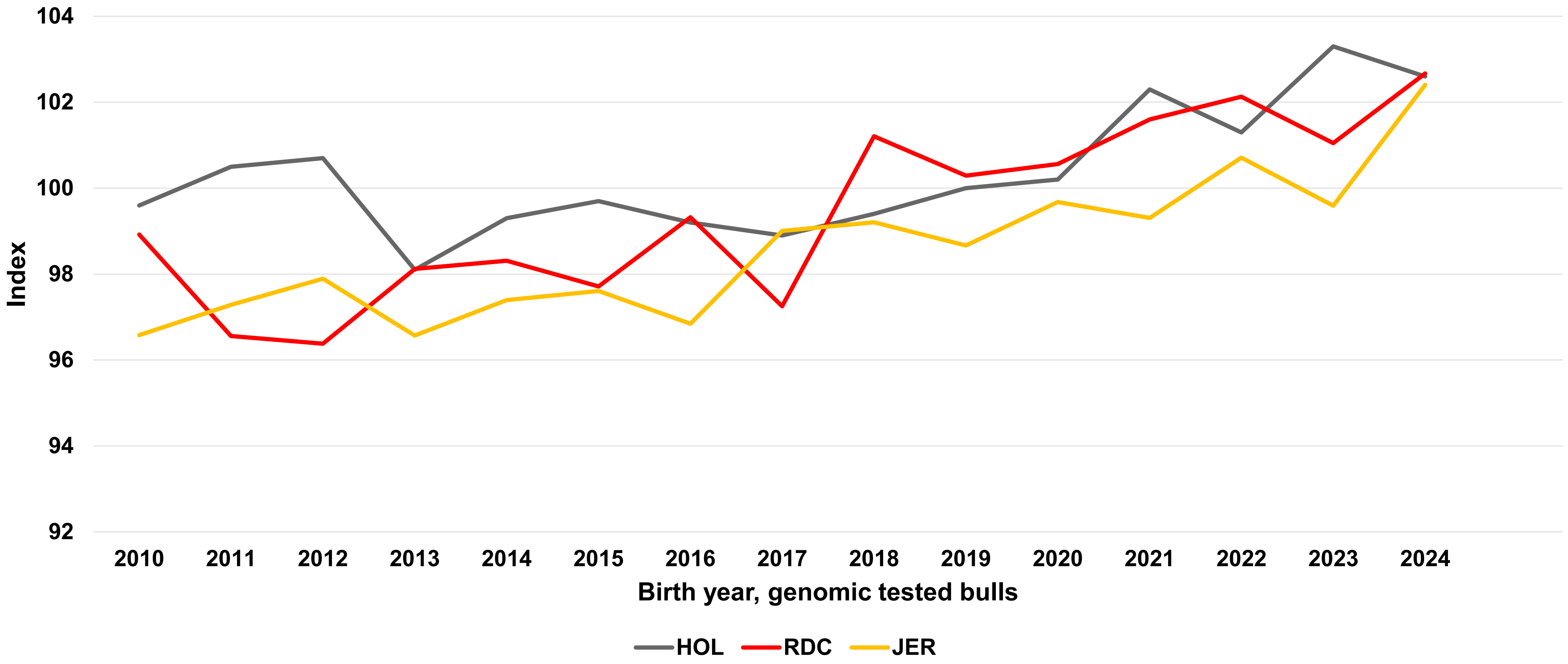
$$\text{GEBV}_{\text{Saved Feed}} = \mathbf{-1} \times (\text{GEBV}_{\text{DMI}} - (0.40 \times \text{GEBV}_{\text{ECM}} + 4.0 \times \text{GEBV}_{\Delta\text{BW}}))$$

Saved Feed indices standardized to a mean of 100 and SD of 10 for 3-5 year old cow’s with data

Candidate bulls have a SD of 6-7

Proven bulls have a SD of ~10

Genetic trend, Saved Feed index



Old versus New Saved Feed indices

Index correlations between old and new **Saved Feed** index:

HOL: 0.30, RDC: 0.50, JER: 0.25

Low correlations caused reranking on Saved Feed index

Limited reranking on NTM (old Saved Feed indices had low emphasis in NTM)

Reasons for changes:

- **Problem** in RFI precorrection step - punished animals with high production
- Measurement errors **accumulated** in RFI phenotype – Least Square RFI challenged in correction for fixed effects

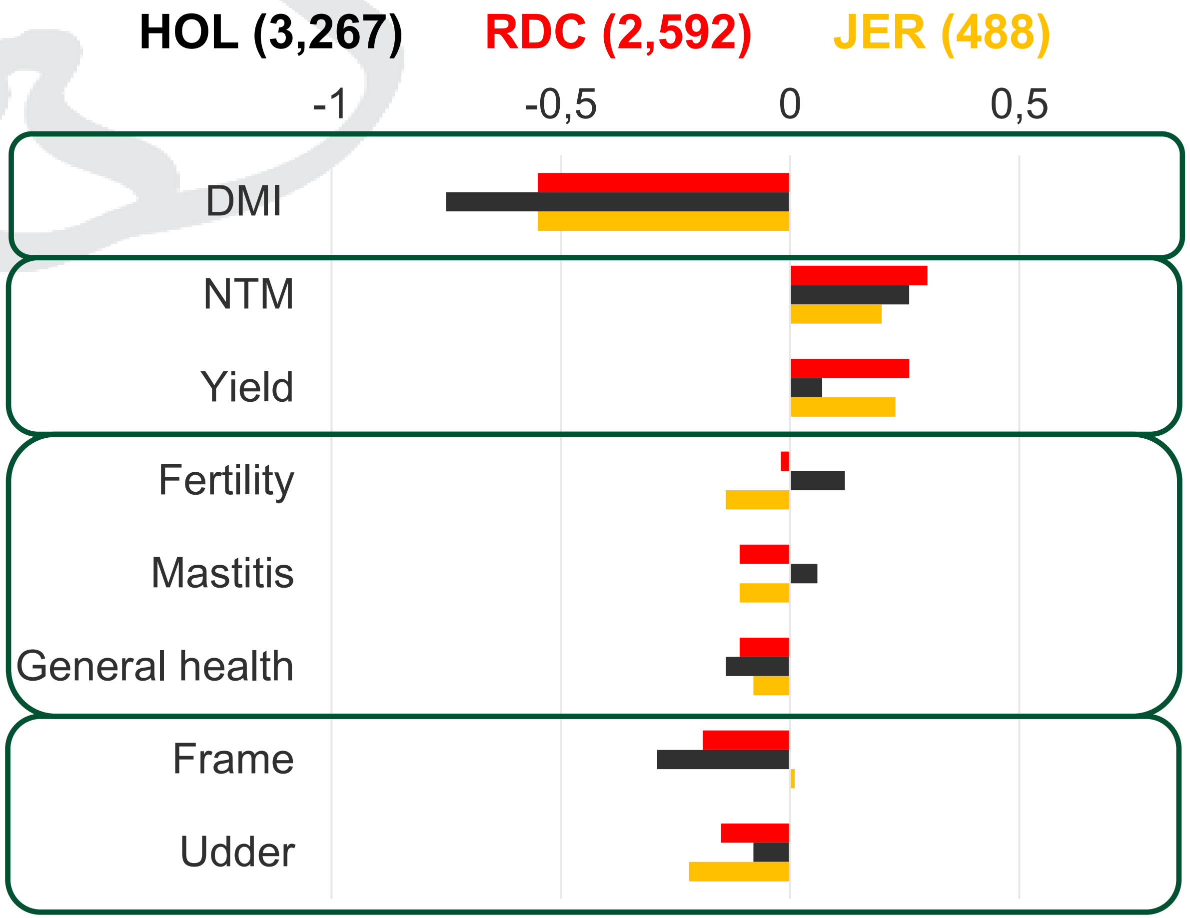
Index correlations for 2022 candidate bulls

Clear reduction in feed intake

Moderate correlation to NTM

Zero or low correlations with functional traits

Large-breeds will reduce frame



Index correlations for 2022 candidate bulls

Low negative index correlations between Saved Feed & functional traits comes from DMI and ECM

Favorable effect of smaller Holstein cows on longevity

Holstein	SF	DMI	ECM	BW
Fertility	-0.05	-0.10	-0.20	0.00
Udder health	-0.10	-0.05	-0.15	0.05
General health	-0.10	-0.15	-0.30	0.00
Young stock surv.	0.10	-0.20	0.10	-0.20
Longevity	0.05	0.00	0.00	-0.20

Take-home messages

Updated NAV Saved Feed index

- Moderate correlation to Nordic breeding goal - **NTM**
- More **efficient** reduction in dry matter intake
- No negative correlation to **Yield**
- Index has a large **economic** value
- Official from **February** 2025

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