Service & Daten
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2023 Interbull Annual Meeting, August 26 to 27, Lyon, France

RZPersistenz

Genetic evaluation of persistency in extended lactations

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Leen Polman

- Performed the analyses
- Implemented the results

- Currently on a transalpes hiking tour

Lactation persistency

Persistency = Maintenance of performance (milk, fat, protein) after peak

Knight and Wilde (1993)
Cole and Null (2009)

- More and more dairy farmers want to increase the length of the lactation
  - low HOL calf prizes, risks of calving, less dry periods, easier management, …
- The goal of RZPersistenz:
  - Allow for selection of animals that are suited to keep high production levels in extended lactations
  - Start after the lactation peak
  - ➢ Target trait: persistency in long lactations even well beyond 305 days
- Random-Regression-Test-Day-Model (RRTDM) gives results for DIMs up to 305
  - Average lactation length of complete lactation approx. 355-360

	Ø yield and lactation length*			
Lac.	**milk**	**fat**	**protein**	**DIM**
1	9654	385	331	360
2	10.701	429	371	355
3	11.137	447	380	356

* min. 270 DIM & following calving

Random-Regression-Model

Genetic effect

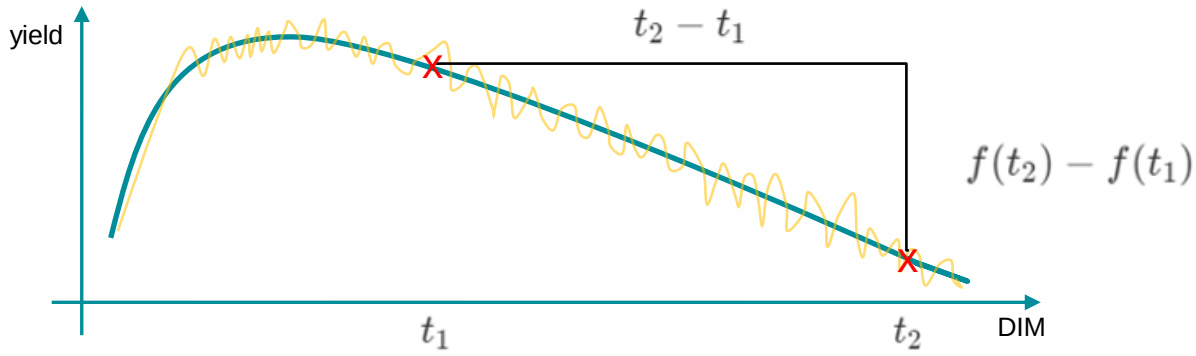
$$y_{ijklo} = h_{il} + \sum_{m=1}^{3} \beta_{jlm} f_{jlm} + \boxed{\sum_{m=1}^{3} b_{klm} a_{klm}} + \sum_{m=1}^{3} b_{klm} p_{klm} + e_{ijklo}$$

y_{ijklo}	is 24-hour test day yield, adjusted for heterogeneous herd variance of the *o*-th test day of lactation *l* of cow *k*
h_{il}	is fixed effects of the *i*-th herd-test-date x milking-frequency (HTD) for lactation *l*
f_{jlm}	represents the *m*-th regression coefficient for the *j*-th fixed lactation curve of lactation *l*
β_{jlm}	is the *m*-th term of Wilmink function with mit $\beta_{..1}=1$, $\beta_{..2}=d$ und $\beta_{..3}=e^{-0.05d}$ and *d* denoting days in milk (DIM)
a_{klm} ; p_{klm}	is the *m*-th random regression coefficient of lactation *l* of cow *k* for genetic and permanent environmental effects, respectively
b_{klm}	the m-th term of the third-order Legendre polynomials with $b_{..1} = 1$, $b_{..2} = \sqrt{3}z$ und $b_{..3} = \frac{1}{2}\sqrt{5}(3z^2 - 1)$ und $z = \frac{(d-5)}{150} - 1$ of lactation *l* of cow *k*
e_{ijklm}	error effect

$$f(t) = [\frac{3\sqrt{5}}{2}[(\frac{t}{150})^2 - \frac{310t}{150^2} + (\frac{155}{150})^2] - \frac{\sqrt{5}}{2}] \quad a_2 + \sqrt{3}(\frac{t-155}{150}) \quad a_1 + a_0$$

Linear slope between two points = Mean daily slope in time Intervall

$$\frac{f(t_2) - f(t_1)}{t_2 - t_1} =$$



150 **305**

$$\frac{f(t_2) - f(t_1)}{t_2 - t_1} = [\frac{3\sqrt{5}((\frac{t_2}{150})^2 - \frac{310t_2}{150^2} + (\frac{155}{150})^2) - \sqrt{5}}{2} \quad a_2 + \sqrt{3}(\frac{t_2 - 155}{150}) \quad a_1 + \quad a_0]$$

$$- [\frac{3\sqrt{5}((\frac{t_1}{150})^2 - \frac{310t_1}{150^2} + (\frac{155}{150^2})^2) - \sqrt{5}}{2} \quad a_2 + \sqrt{3}(\frac{t_1 - 155}{150}) \quad a_1 + \quad a_0]$$

$$= \boxed{\frac{3\sqrt{5}}{2}(\frac{t_2^2 - t_1^2}{150^2} - \frac{310(t_2 - t_1)}{150^2})} \qquad a_2 + \boxed{\frac{\sqrt{3}}{150}(t_2 - t_1)} \quad a_1$$

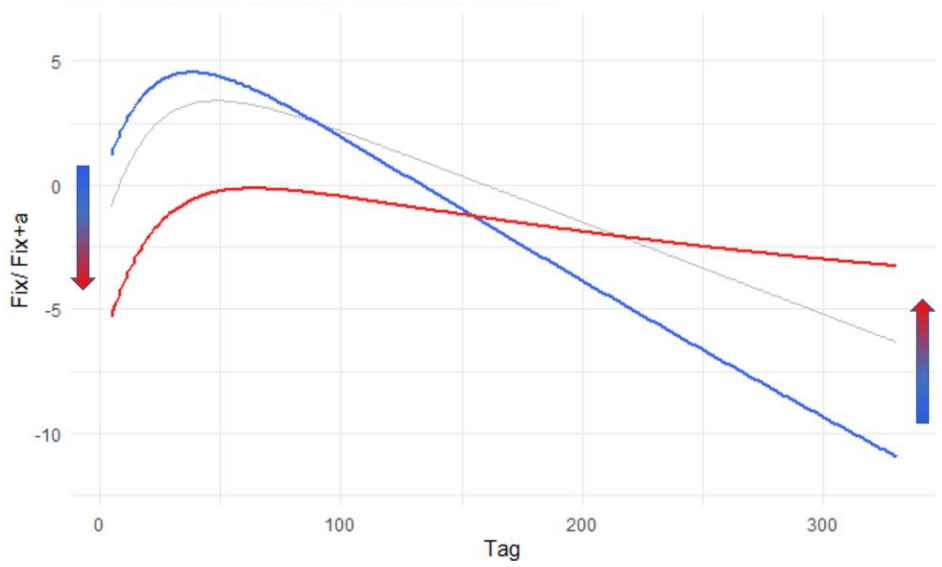
0.65 **0.35**

➔ **It's only a weighting between coefficient a_1 and a_2!**

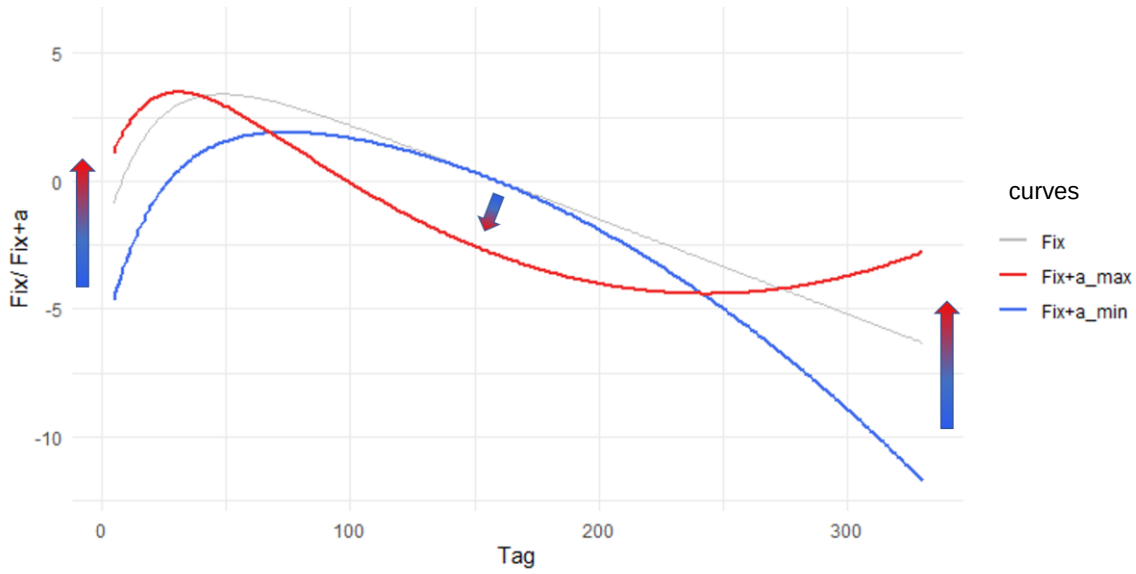
The concept

- How do in principle the polynomials a1 and a2 effect the shape/progression of the curves?
  - Master's thesis by Leen Polman (2021): estimated lactation curves of ca. 5,000 AI bulls from RUW
  - Here, the mean fix lactation curve was added, to get the shape of a lactation curve

milk L1: coefficient variation **a1** from min to max



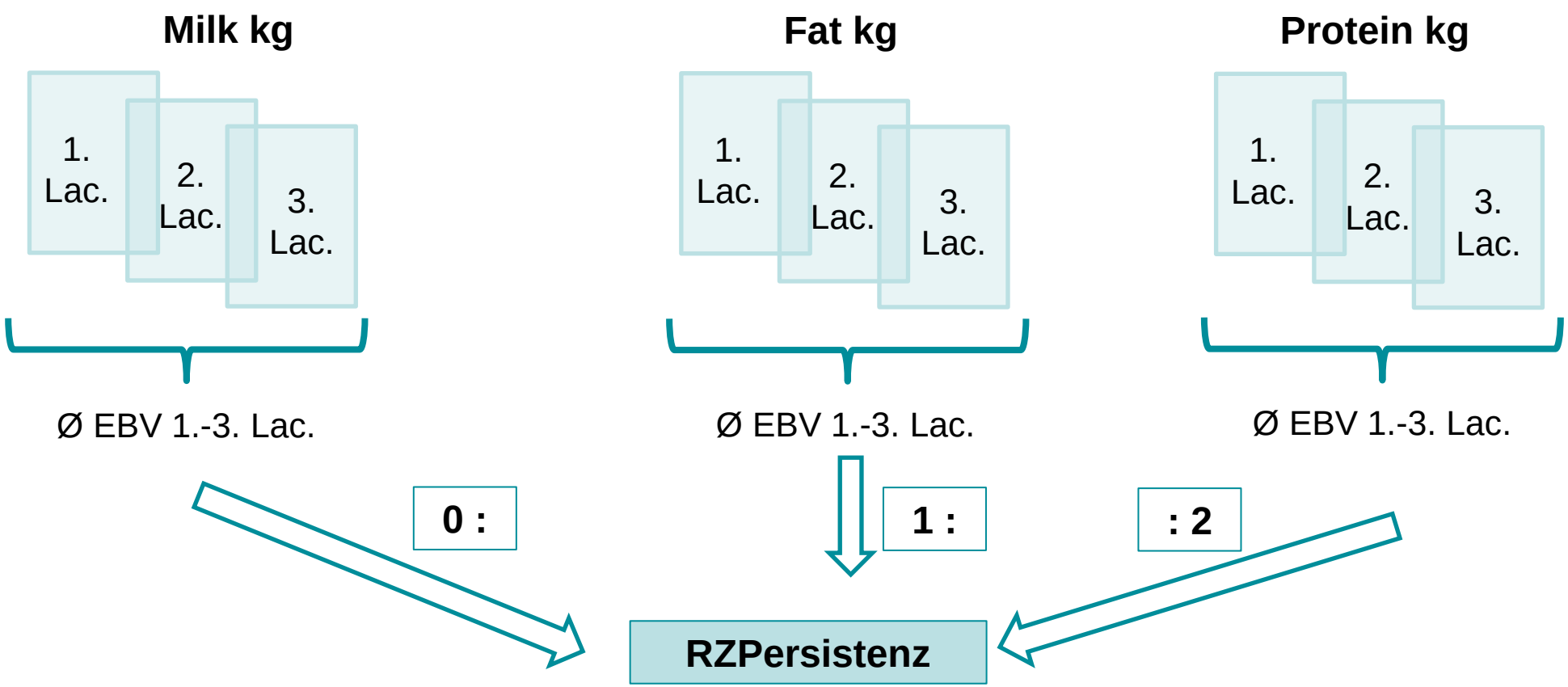
milk L1: coefficient variation **a2** from min to max



The larger the coefficients, the higher persistency in longer lactations → how to combine?

Definition of relative EBV for persistency (RZPersistenz)

- Weights of relative EBV for persistency analogous to RZM calculation



Economically based as in production index RZM

Heritability (diagonal) and genetic correlations (above diagonal)

single trait and lactation level

	L1_my	L2_my	L3_my
L1_my	**0.15**	0.84	0.80
L2_my		**0.20**	0.98
L3_my			**0.18**

	L1_fy	L2_fy	L3_fy
L1_fy	**0.09**	0.85	0.77
L2_fy		**0.11**	0.95
L3_fy			**0.11**

	L1_py	L2_py	L3_py
L1_py	**0.12**	0.84	0.77
L2_py		**0.16**	0.98
L3_py			**0.15**

cumulated h^2

	h^2
Milk kg	0.417
Fat kg	0.323
Protein kg	0.353

RZPersistenz

0.343

EBV correlations RZPersistenz to other relative EBVs

- gEBV correlations based on German females born 2022 from herd genotyping (EBV Dec. 2022)
  - Large number, represents variation in population ➔ realistic genetic correlation

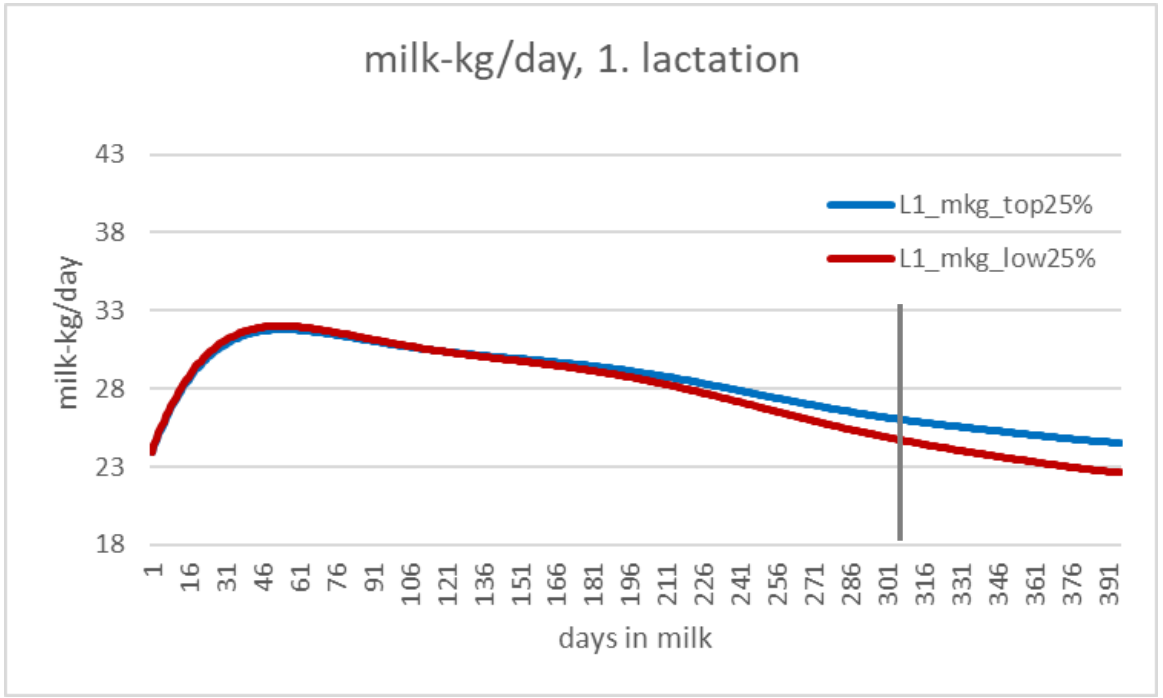
Persistency gEBV correlation to	**Trait**	**Holstein females** (born 2022)
No. of animals		*105'557*
RZM	yield	0.24
RZN	longevity	0.18
RZE	conformation	0.06
RZR	fertility	-0.06
RZGesund	health	0.12
RZKm	calving, mat.	0.03
RZKd	calving, dir.	0.09
RZKälberfit	calf survival	0.00

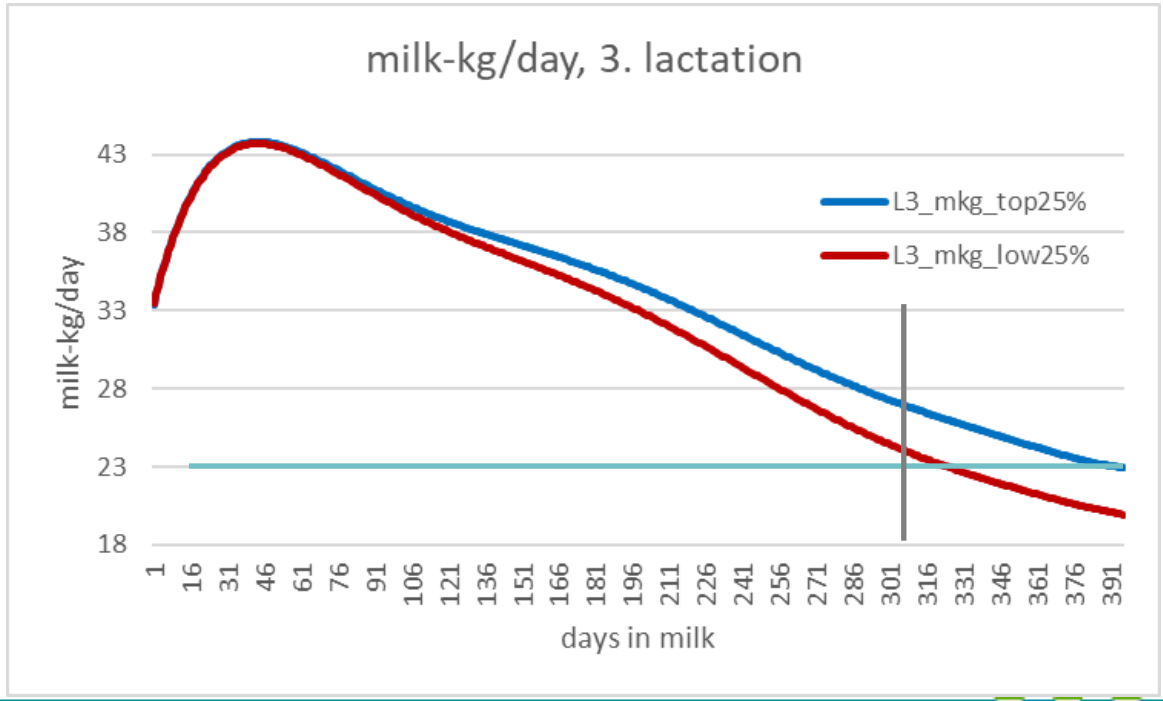
- Slightly positive correlations to yield index and longevity
  - and therefore, also to RZG (TMI)
- Correlations to other components of RZG close to zero

Phenotypic lactation curves of animals with high/low RZPersistenz

- Daughters of Holstein AI bulls (Top/Bottom 25% RZPersistenz)
  - ca. 1.000 AI bulls born 2013-2016
- Mean phenotypic curves of daughters
  - approx. 200.000 daughters each 25% group
  - Top 25%: ∅ 117,6 RZPersistenz
  - Bottom 25%: ∅ 94,6 RZPersistenz

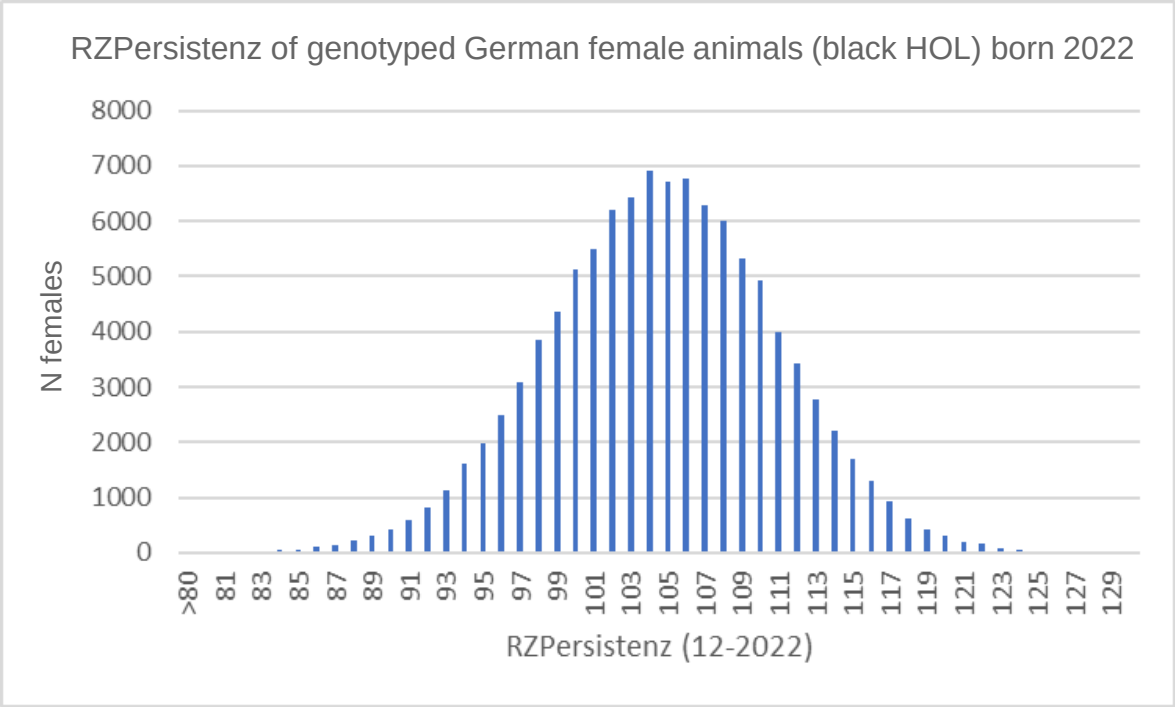
Milk kg





Reliability and variation of genomic RZPersistenz

- Reference population for RZPersistenz is smaller than for milk yield traits and cell count
  - Only animals in German RRTDM have information on lactation curve available
    - no information on lactation curve for international AI bulls converted by Interbull
  - only cows in reference population if phenotypic information in the second part of lactation is available
- → Reliability of genomic RZPersistenz 60%



gRZPersistenz of German Holstein females born 2022 from herd genotyping (gEBV Dec. 2022; N = 105.557)

RZPersistenz: summary and outlook

- Definition based on ratio between genetic legendre coefficients from RRTDM
  - except the intercept
  - in the future, the RRTDM will be revised to include DIMs up to 400

- Slightly positive correlations to yield index and longevity
  - Therefore, slightly positive genetic trend for persistency in the past
  - Correlations to other components of RZG (TMI) close to zero

- Only farmers with focus on extended lactations should consider the RZPersistenz

The longer the targeted lactation length is,
the more the consideration of the RZPersistenz makes sense

Thank you for your attention!