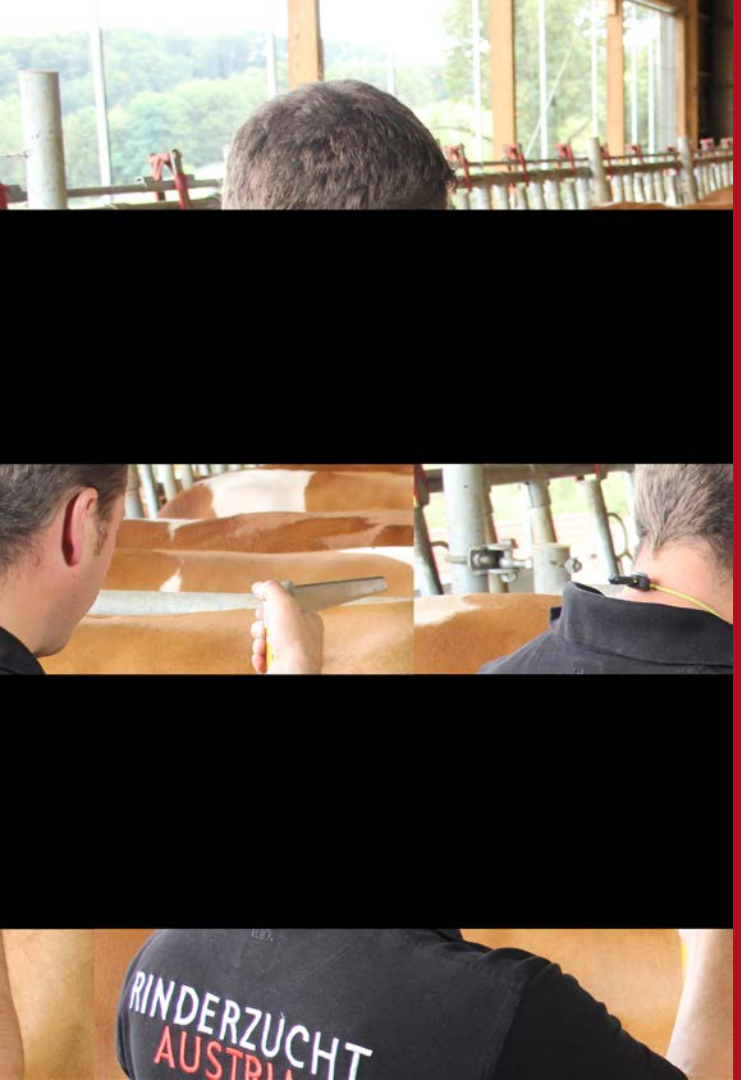

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Recording of feed efficiency under on-farm conditions

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The project „Efficient Cow“

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Recording feed efficiency is a challenge!

- Ways of recording feed efficiency
  - Record the feed intake precisely for a small group of animals on station
  - Estimate feed intake of many animals on farm based on animal and diet information with impact on the feed intake
  - Work with further auxiliary traits like mid-infrared-spectra
- Efficient Cow
  - Finding ways to record/estimate feed efficiency on-farm
  - Looking for possible auxiliary traits for practical use

Recorded data

Data recorded

- General information about farm (housing, feeding, ...)
- Recording of health data
- Documentation of claw trimming
- Test for ketosis based on milk
- Linear scoring of all cows across lactations
- At each time of milk recording in 2014
  - Body weight, body measures, BCS, lameness scoring
  - Information about diet and estimation of feed intake
  - Routine information about milk recording + MIR-spectra
- Austrian main breeds
  - Fleckvieh / Simmental (FL), Brown Swiss (BS), Holstein (HF)

Recorded data – Fleckvieh / Simmental (FL)

	COWS	N	LACT 1	LACT 2	LACT >=3

Estimation of dry matter intake (DMI)

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Estimating feed intake (Gruber et al. 2004)

feed intake = breed + lactgroup + lactday + weight +

+ milk yield + concentrate + NEL (forage)

breed	Fleckvieh, Brown Swiss or Holstein
lactgroup	lactation group (1, 2+3, e4)
lactday	day in milk (days)
weight	body weight (kg)
milk yield	milk yield, not ECM (kg/day)
concentrate	concentrate amount (kg/day)
NEL (forage)	net energy lactation in forage (MJ/kg)

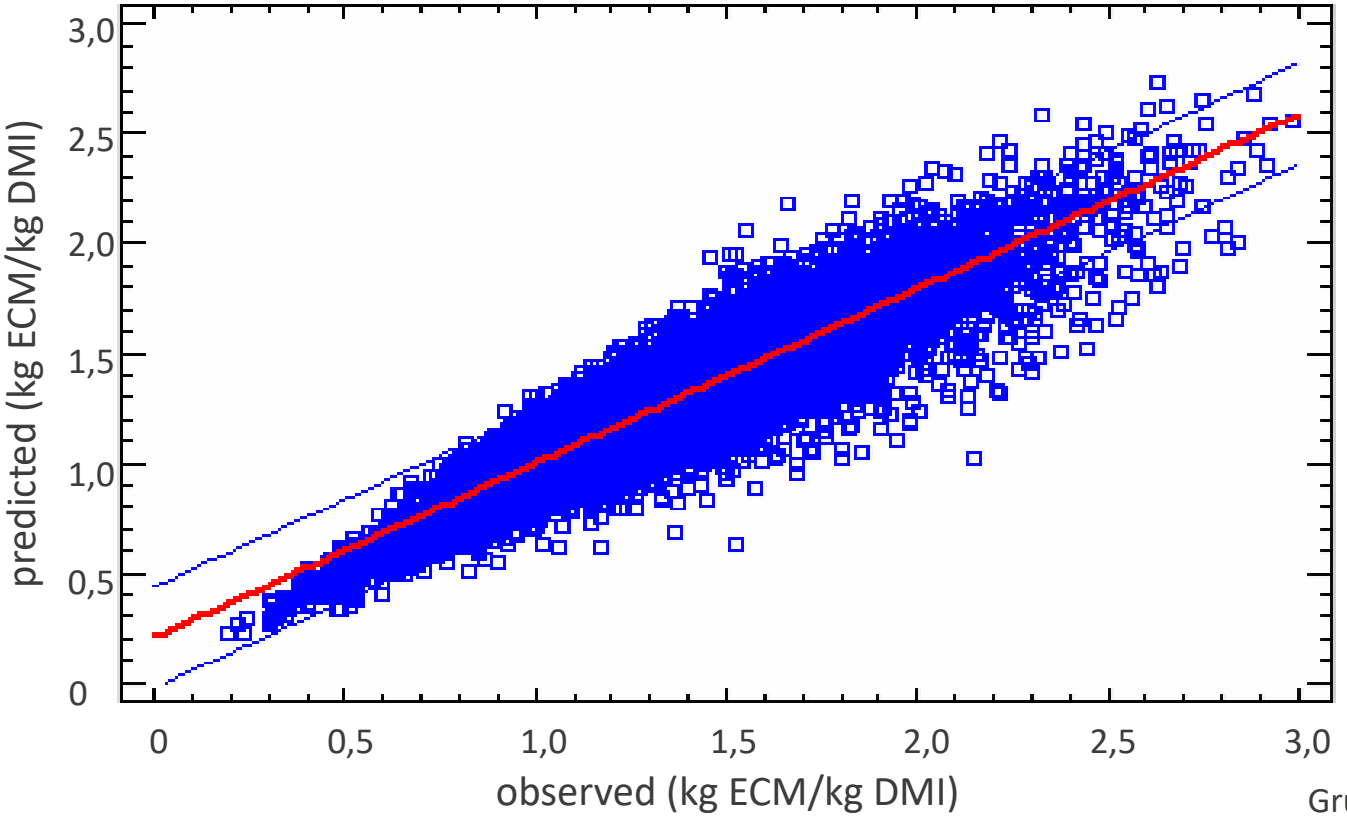
Comparison of 5 models predicting feed intake

Model	obs.	pred.	RMSPE	Bias	Regression	Random
NRC	20.3	21.7	1.80	64.7 %	4.1 %	31.3 %
NorFor	21.3	21.7	1.52	6.1 %	37.7 %	56.3 %
TDMI	20.3	20.2	1.71	0.3 %	22.3 %	77.3 %
Zom	20.3	21.9	3.16	26.3 %	27.9 %	45.8 %
Gruber	20.3	20.5	1.17	3.6 %	2.9 %	93.4 %

Models: NRC (NRC, 2001), NorFor (Volden et al. 2011), TDMI (Huhtanen et al. 2011), Zom (Zom et al., 2012), Gruber (Gruber et al. 2004)
RMSPE: square root of mean square prediction error (MSPE) in kg DM/day

Jensen et al., 2015

Observed vs. predicted feed efficiency



$y = 0.21 + 0.792\ x$

RMSE = 0.12 kg

$R^2 = 0.82$

Pearson Corr. = 0.91

Spearman Rank Corr. = 0.89

Gruber et al., 2016 (in preparation)

Standardizing for 100th day in milk

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Standardizing

- Weight, DMI, NEL-Intake, ECM and ECM / NEL got standardized for lactation day 100 and no pregnancy
- Added the mean of the estimated random effects of each cow and test day to the expected value of an average cow on this farm
- Used software
  - R version 3.2.4 - R Core Team (2016)
  - R packages
    - lme4 – Bates et al. (2014)
    - data.table – Dowle et al.(2015)
    - ggplot2 – Wickham (2009)

Used Models

Y	Lactation group**	Day in milk	Day of gestation	Weight	MJ NEL / kg DMI	Organic farm	Maize %***	g XP / MJ NEL	Age at first calving	farm*	animal within fram*
Weight	X	log^2	X^2				X		X	X	X
DMI	X	log^2	X^3	X^2	X	X		X		X	X
NEL-Intake	X	log^2			X^2	X				X	X
ECM	X	X^2	X^2	X^2	X	X	X			X	X
ECM / NEL	X	X^3	X^2	X^2	X					X	X

* ... (Nested) random effects are marked grey, all others used as fixed effects

** ... 1., 2. and ≥3. Lactation, except ECM/NEL: 1.+2. and ≥3. Lactation

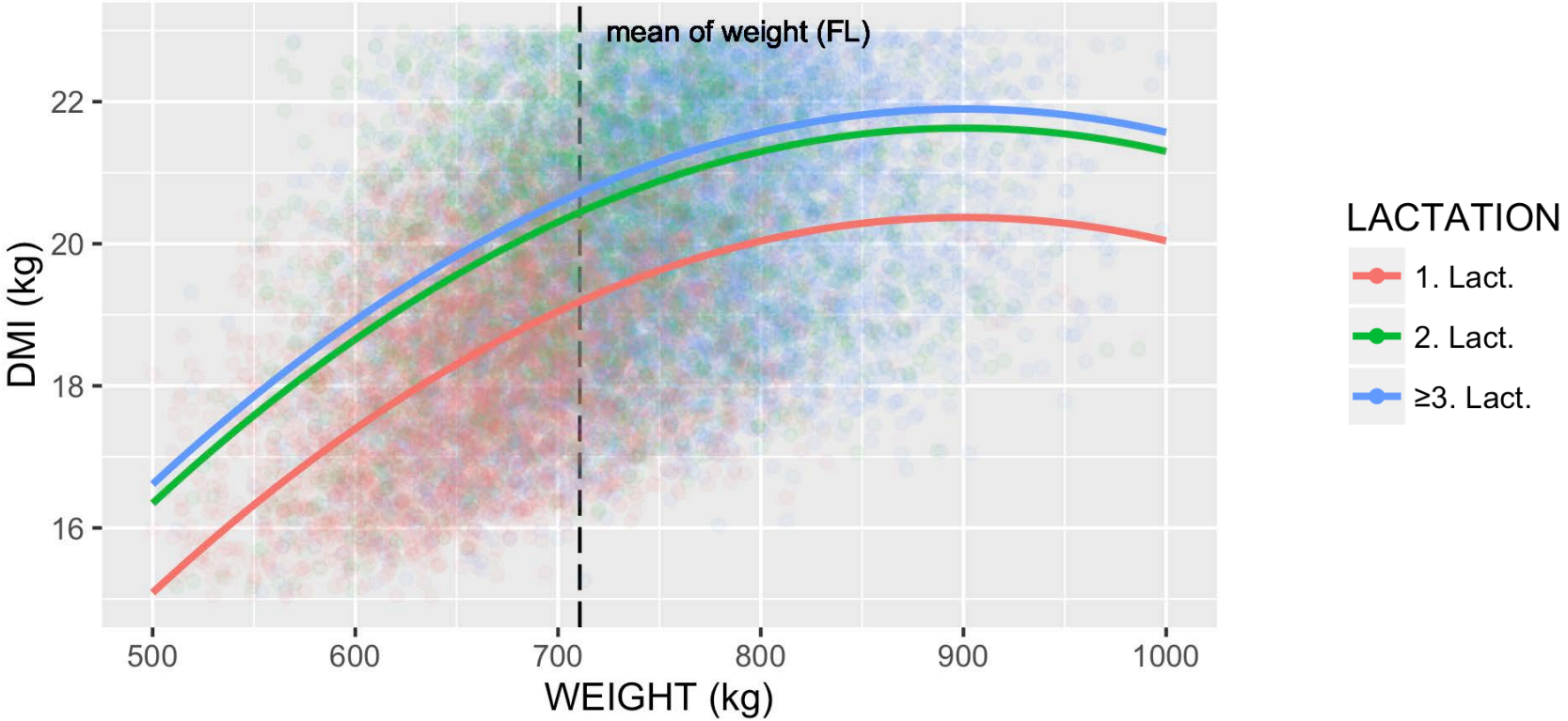
*** ... 3 groups: no maize, < 35% and ≥35% maize in diet

Results

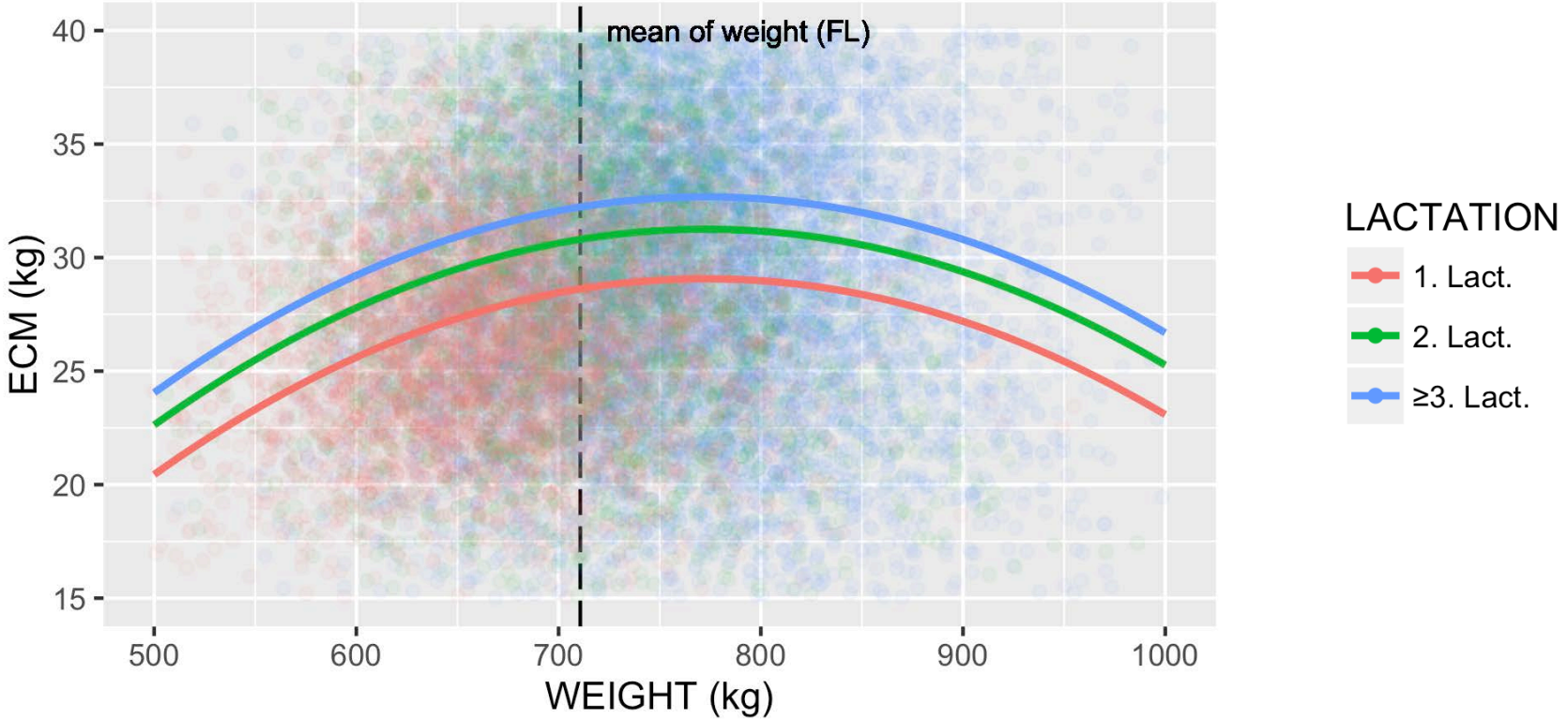
Standardized Data – Fleckvieh / Simmental (FL)

n = 2796 cows ≥3 observations in lact.	MIN	MAX	LACT 1	LACT 2	LACT ≥3

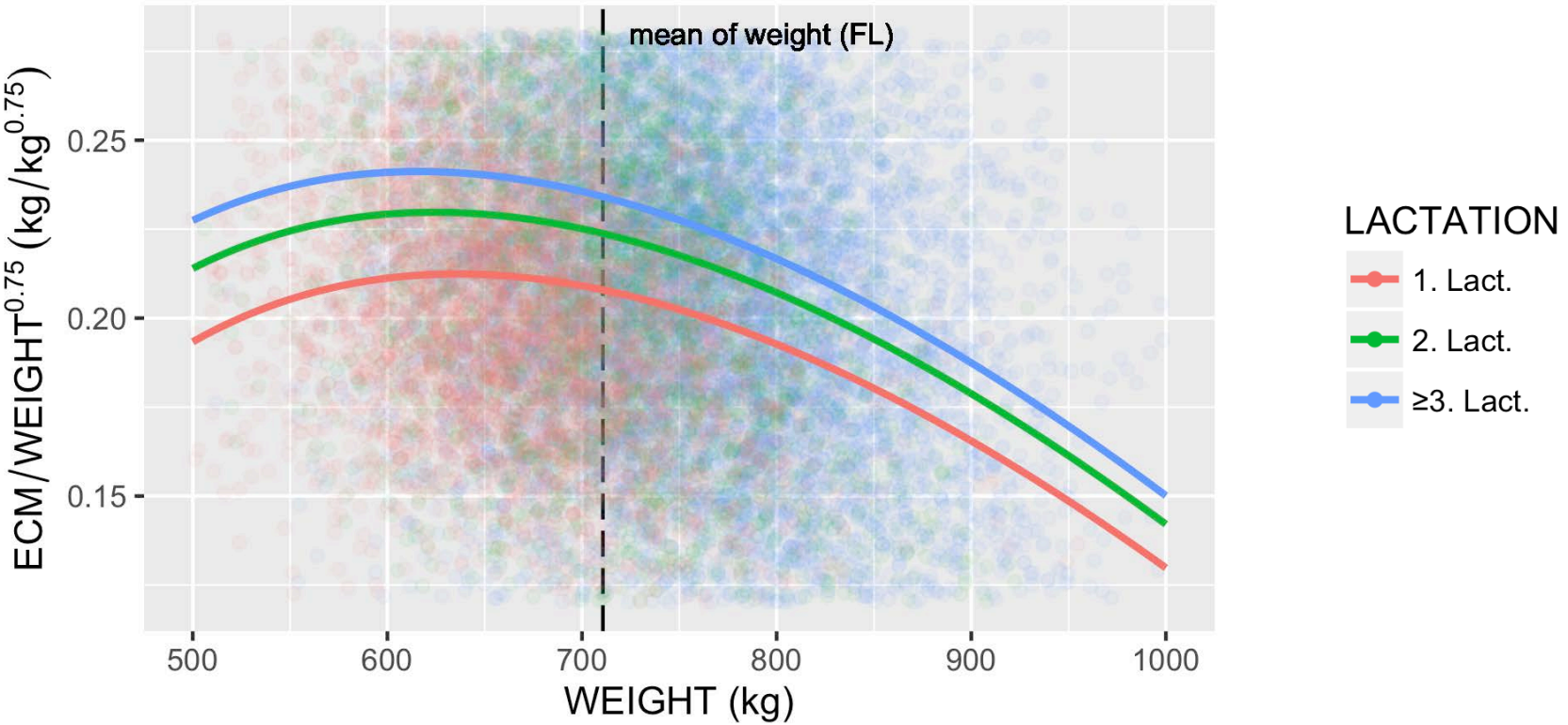
Link between weight and DMI (FL)



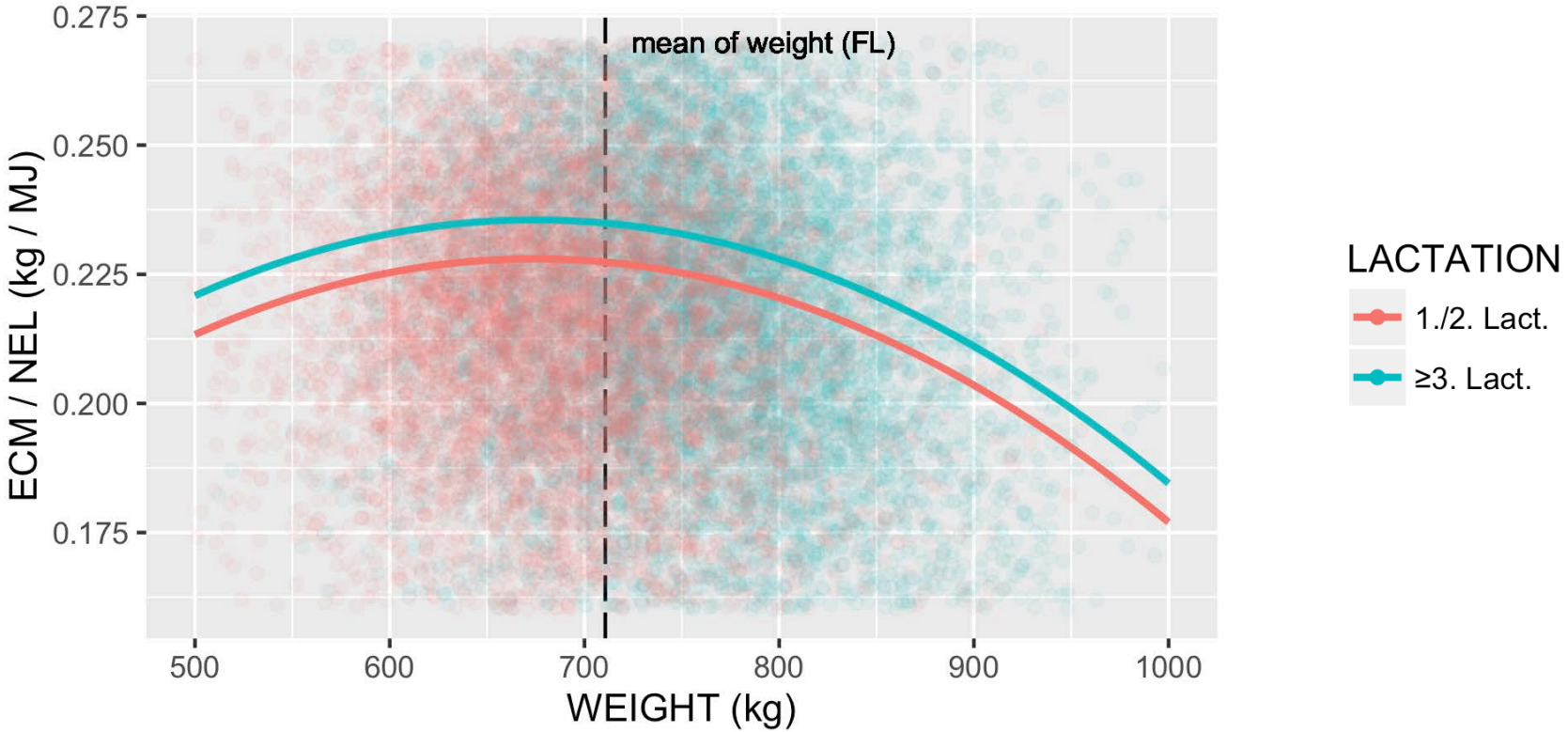
Link between weight and ECM (FL)



Link between weight and ECM / metab. weight (FL)



Link between weight and ECM / NEL (FL)



Conclusions

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Conclusions for practical use

- Data recording from about 5,300 cows under on-farm-conditions was a big challenge
- Body weight has high impact on feed efficiency
- Recording of body weight was easier to handle than taking different body measures, but time of weighing influences result
- Practical use of diet information would need also reliable weights and information on mobilization (maybe from MIR spectra)
- With estimated DMI efficiency traits like residual feed intake (RFI) doesn't make sense and results have been carefully interpreted.
  - What do we really see, when cows differ in kg ECM / MJ NEL?

Perspective

- Discussion about Findings out of Efficient Cow started in Austria
- Short term: only weight (or auxiliary traits like conformation traits - frame, muscularity, body measures) as important impact factor on feed efficiency possible
- Long term: estimation of breeding values for claw health and metabolism interesting
- But all results and ideas have to get discussed with our partners in Germany and Czech Republic

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Thank you for your attention!

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