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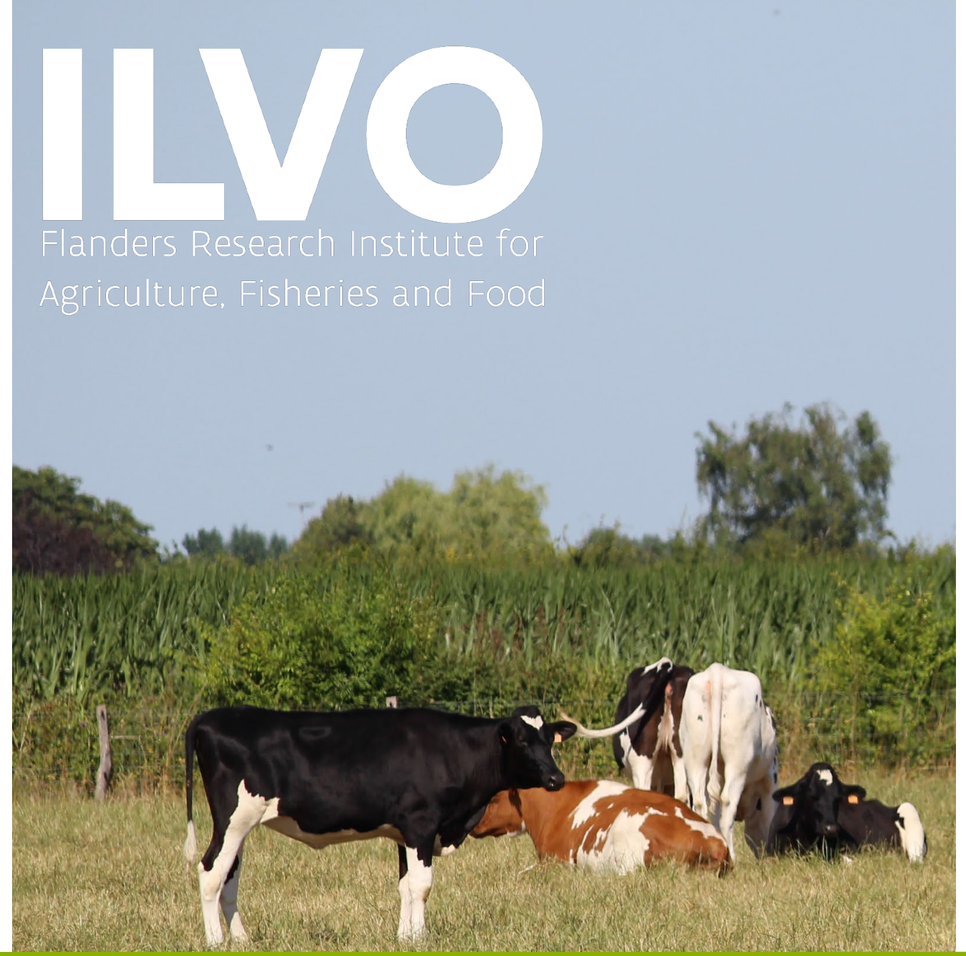

Impact of growth rate of dairy heifers on long term performance:

A quantile regression analysis

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JongLeven

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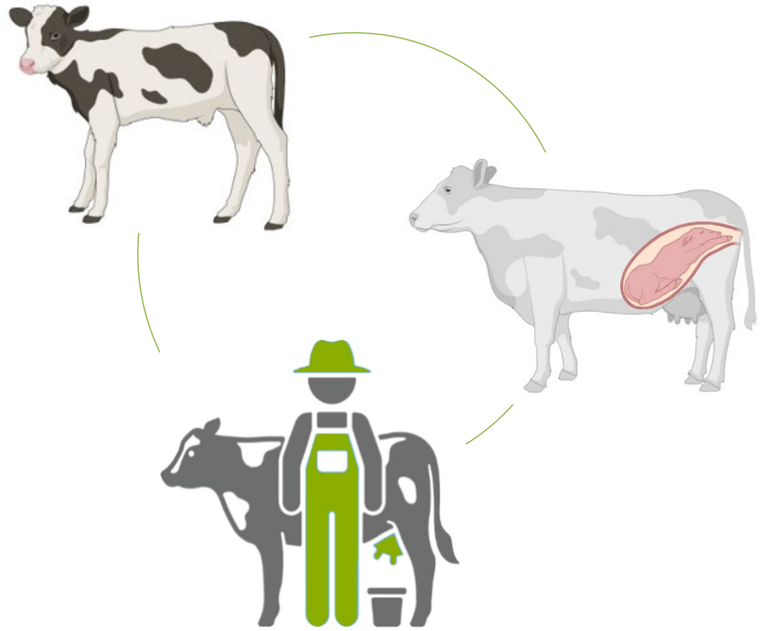
Introduction

Raising dairy heifers

↑ Average Daily Gain (ADG)



↓ Age at First Calving (AFC)

Milk production

€

High costs

- 20% of annual dairy farm cost[1]
- > range €1423 - €1715[2]

↓ AFC = reach puberty earlier

- Correlation body weight and puberty[3]
- Accelerated growth rate

↑ ADG: impact[4] on

- Mammary gland development?
- First lactation production?

[1]Heinrichs, 1993
[2]Nor et al., 2012; ILVO unpublished data
[3]Sejrsen et al., 1982
[4]Volkmann et al., 2019; Broucek et al., 2021; Niwińska et al., 2022)

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Eval

Wei et al. (2005)

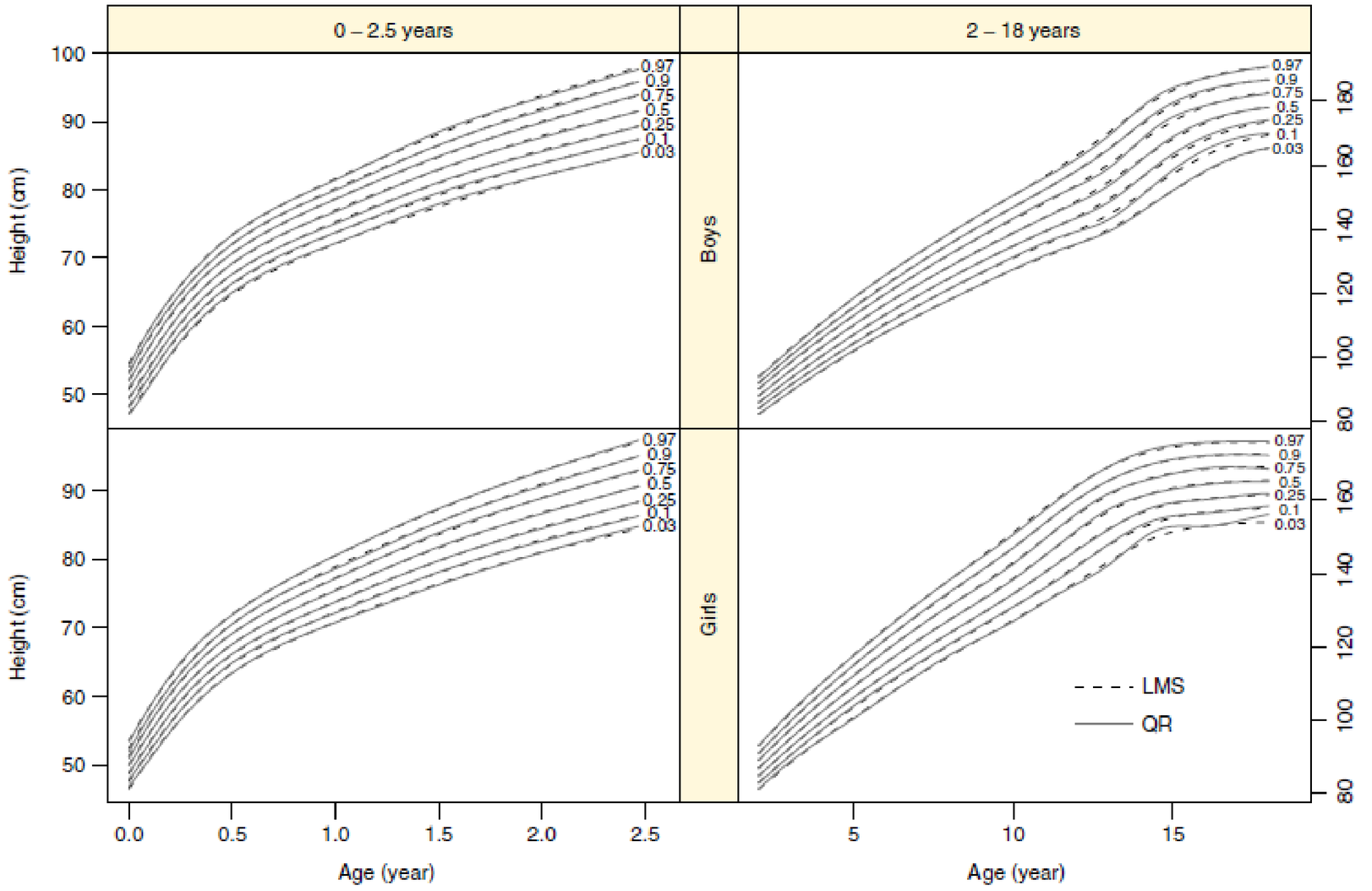

Figure 2. Comparison of LMS and QR growth curves: the figure illustrates two families of growth curves, the dashed curves are estimated with the LMS methods of Cole and Green, while the solid curves are estimated using quantile regression methods.

Experi
setting

- Consistent in
- ADG W2– W4

cal
g
rms)

labor-intensive
t different ages
illness; grazing)
nents per heifer
rowth intervals

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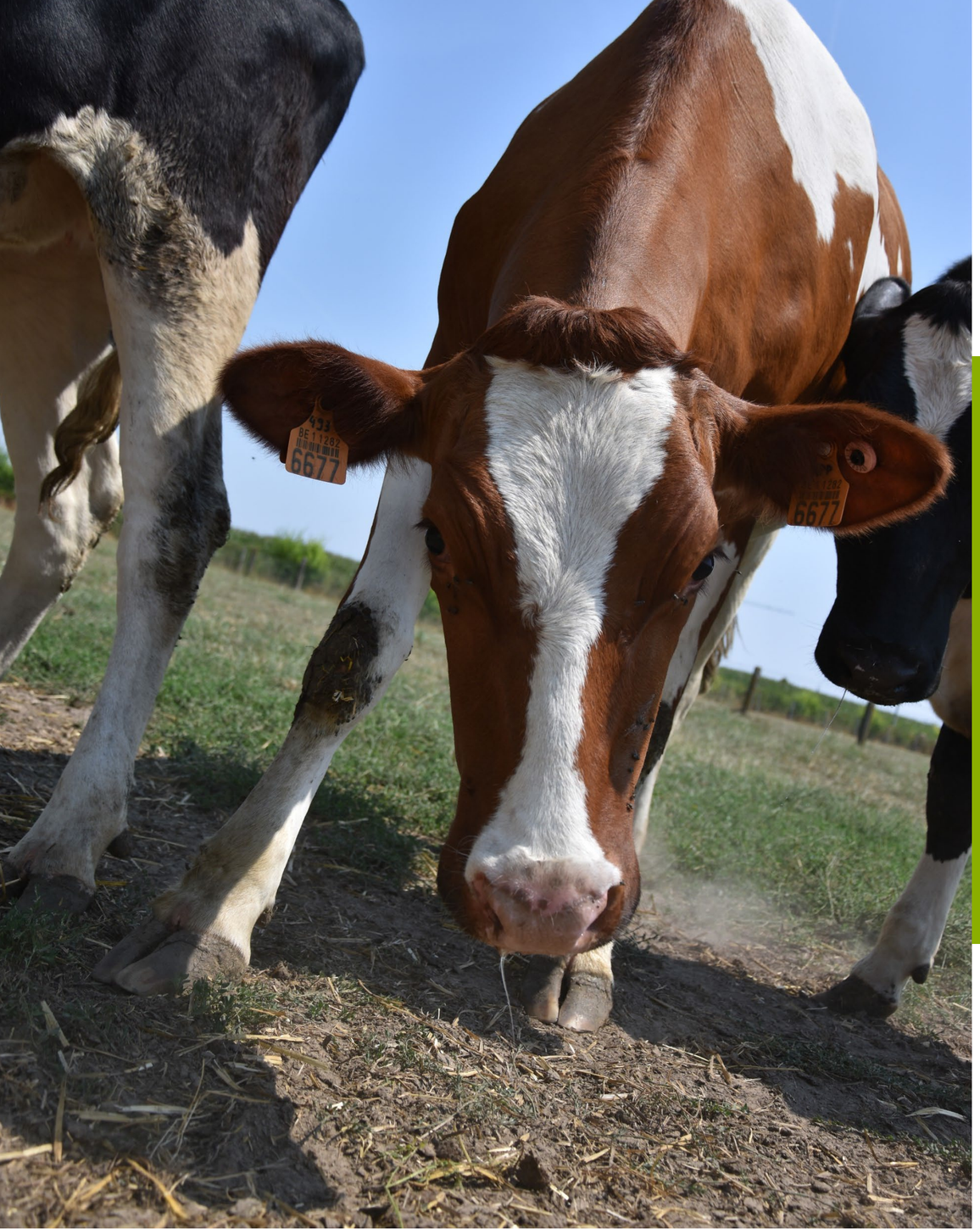

Objectives

1) Assess the impact of ADG on fertility and 1st lactation by using a quantile regression analysis (QRA)
2) Validate this approach as an effective method in evaluating the impact of growth in dairy heifers

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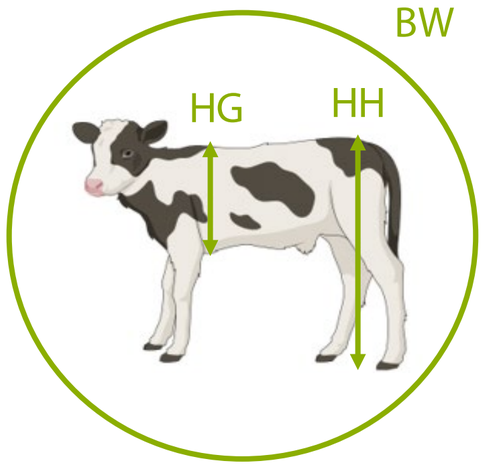
N=30

Materials & Methods



N=5,458 heifers

Growth monitoring program=dataset 1

- January 2018 - December 2023
- Quaterly visits to 30 farms
- Body weight (BW), hip height (HH) and heart girth (HG)
- All heifers: from birth until 1 month prior to calving

Data collection= dataset 2

- January 2022 - July 2024
- Collecting dairy herd improvement (DHI) data (n=29)
  - *1 farm daily recordings (milk robot)*
  - *1 farm excluded (cessation DHI during project)*
- Animal characteristics, fertility parameters, 305-d production parameters during 1st lactation *(based on mean DHI per lactation)*
  - Inclusion of archived animals
- 2,783 heifers (1st lactation)

N=29

Materials & Methods

Inclusion criteria

- Born after January 2018
- Inclusion of heifers until 4th lactation
- Minimal length per lactation >100 days
- AFC > age first breeding & >19 months

Statistical analysis

- Fertility/production parameters: Effect quantile
- Production parameters : Effect quantile * AFC category
  - Very low AFC= <21 m
  - Low AFC= 21-23 m
  - Mean AFC= 23-25m
  - High AFC = >25m

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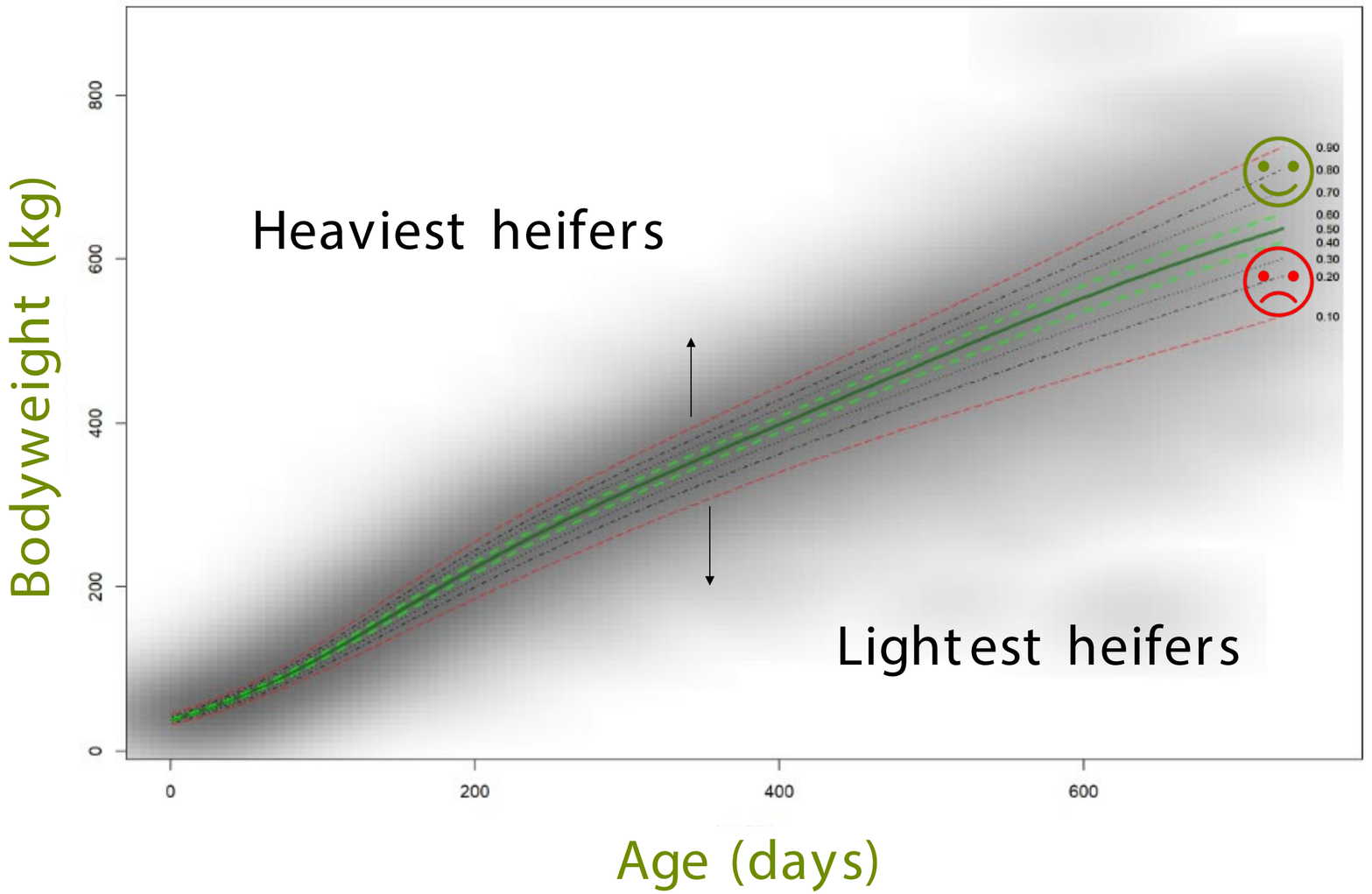
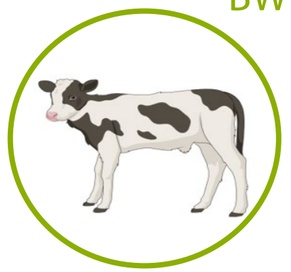


$Q_{0,75}$ = fast growers ☺
$Q_{0,50}$ = average growers
$Q_{0,25}$ = slow growers ☹

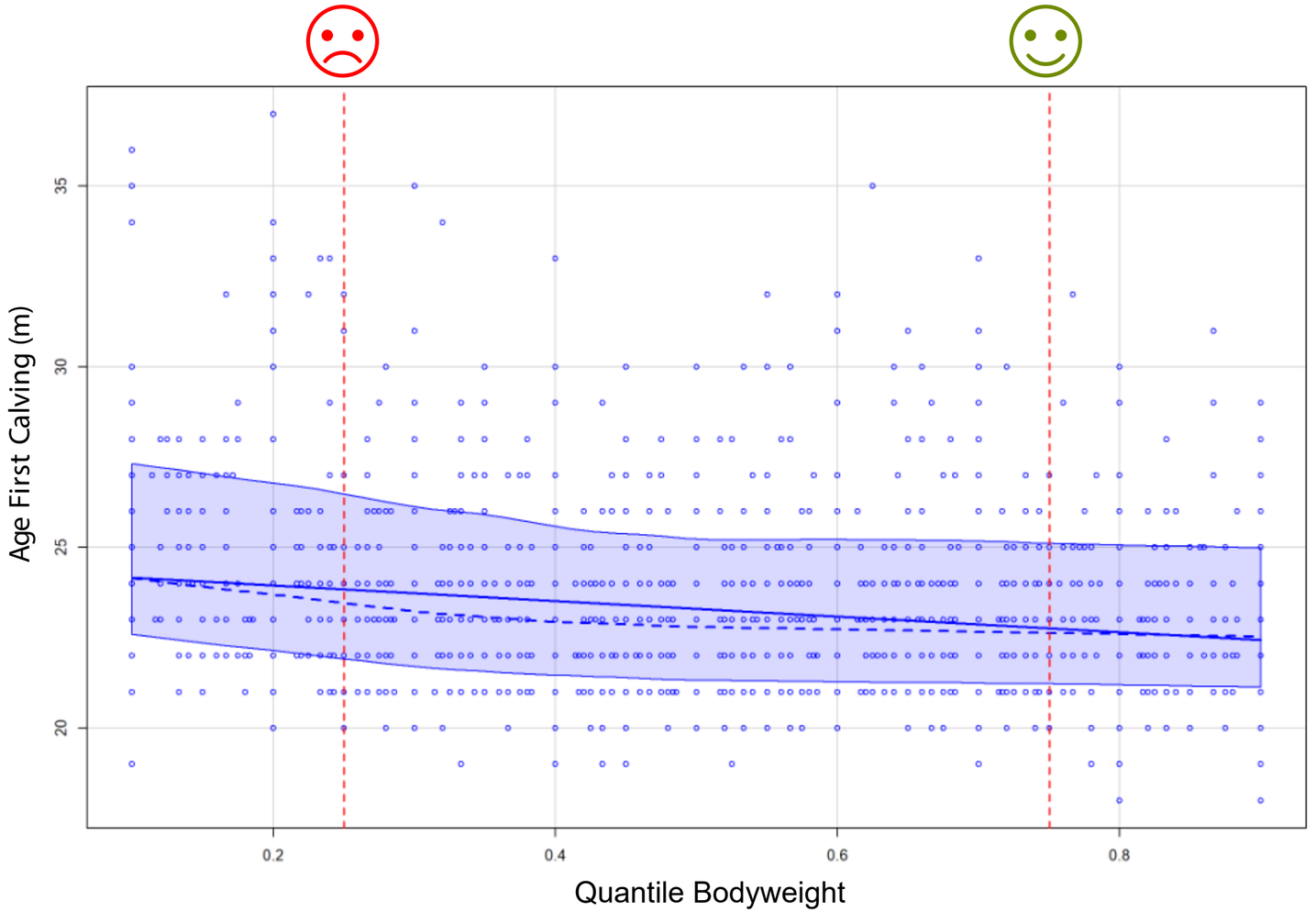
Results & Discussion

Reaching puberty earlier[1,2,3] -> earlier AFB & AFC



Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	23,9	22,8	- 1,1 m
Hip Height	23,7	22,9	-0,8 m
Heart girth	23,7	23,0	-0,7 m

Least square means of the linear model, p value <0,001



Effect quantile BW on Age First Breeding:

$\Delta Q_{0,75} - Q_{0,25}$ =-27 days

[1]Shamay et al. (2005)
[2]Raeth-Knight et al. (2009)
[3]Macdonald et al. (2005)

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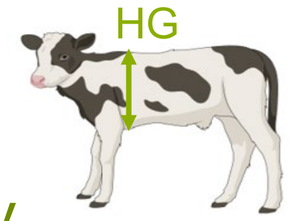
Results



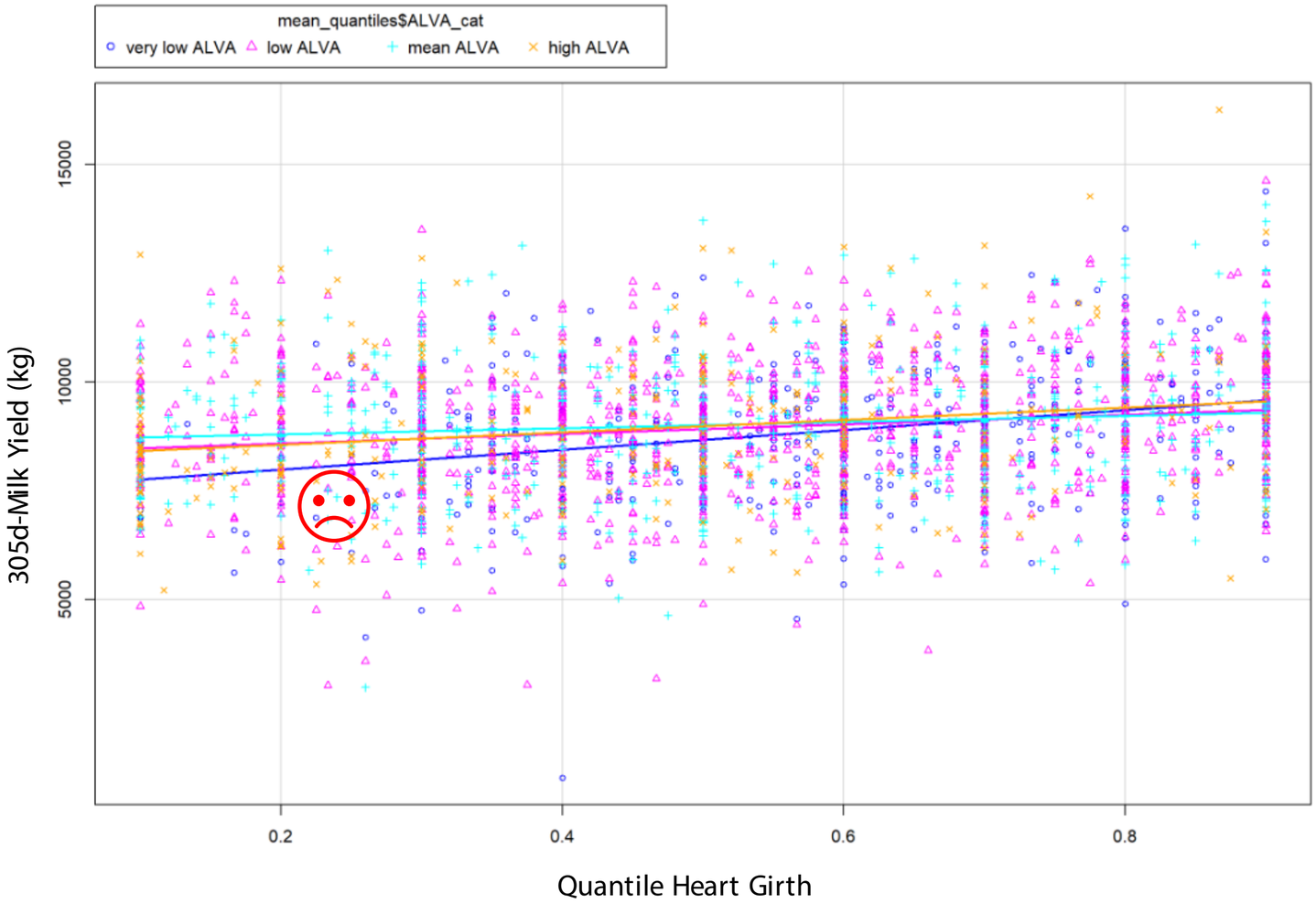
Higher milk yield[4,5] -> unaffected mammary gland development during puberty
Weaker effect for smallest heifers with AFC<21M

Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	8551	9362	+810 kg ☺
Hip Height	8611	9361	+750 kg ☺
Heart girth	8634	9269	+635 kg* ☺

Least square means of the linear model, p value <0,001
*Significant interaction with **AFC category** (p<0,05)

Very low AFC <21M	Low AFC 21 - 23M	Avg AFC 23 - 25M	High AFC >25M
+1133 [b] ☹	+548 [a]	+356 [a]	+709 [ab]

Post hoc test (emmean), confidence level used: 0,95



[4]Moallem et al. (2010)
[5]Volkmann et al. (2019)

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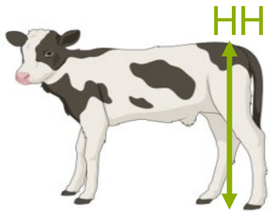
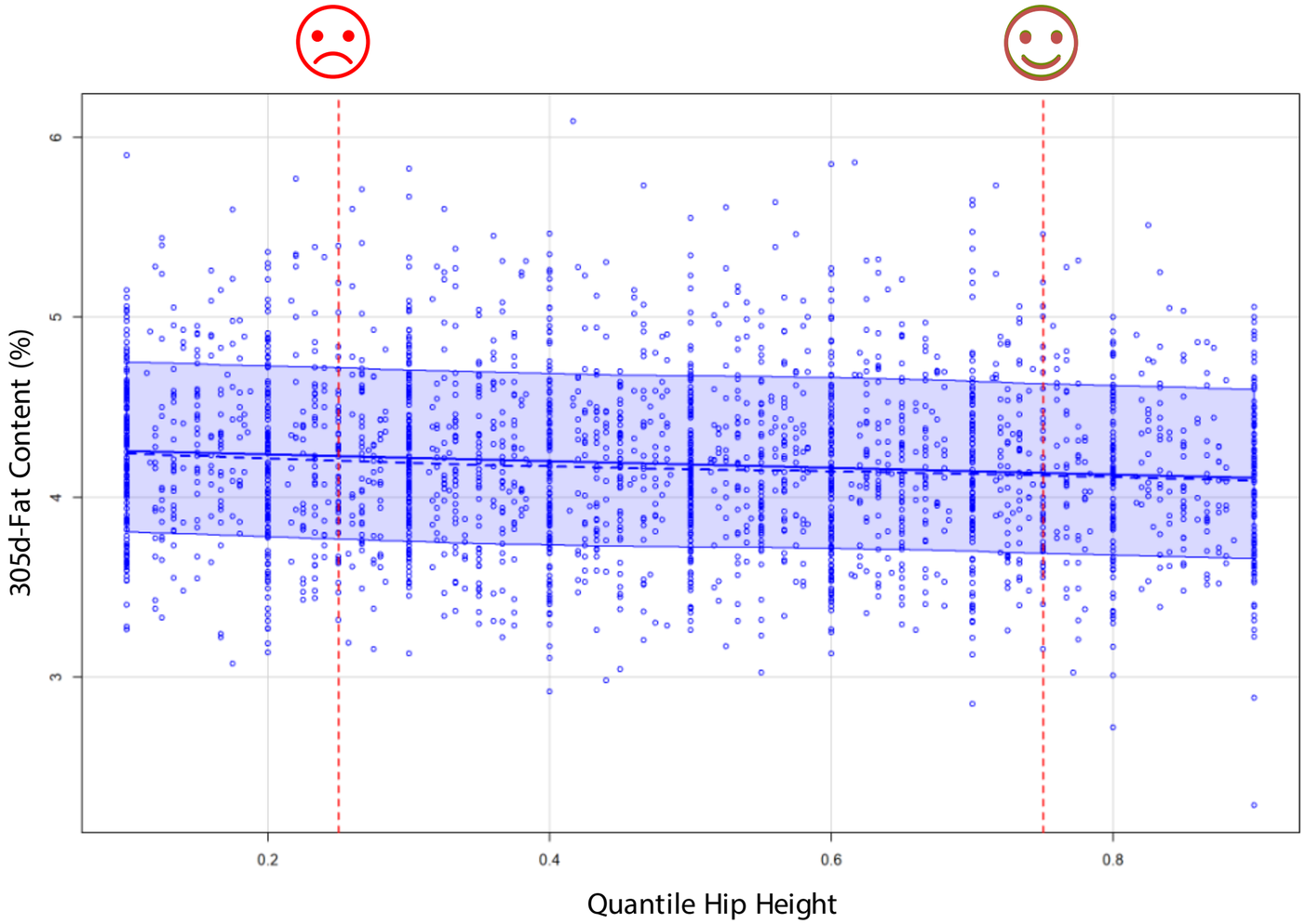
Results

305d -Fat Content

Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	4,20	4,18	NS
Hip Height	4,23	4,13	-0,10%
Heart girth	4,22	4,16	-0,06%

Least square means of the linear model, p value <0,005





Results

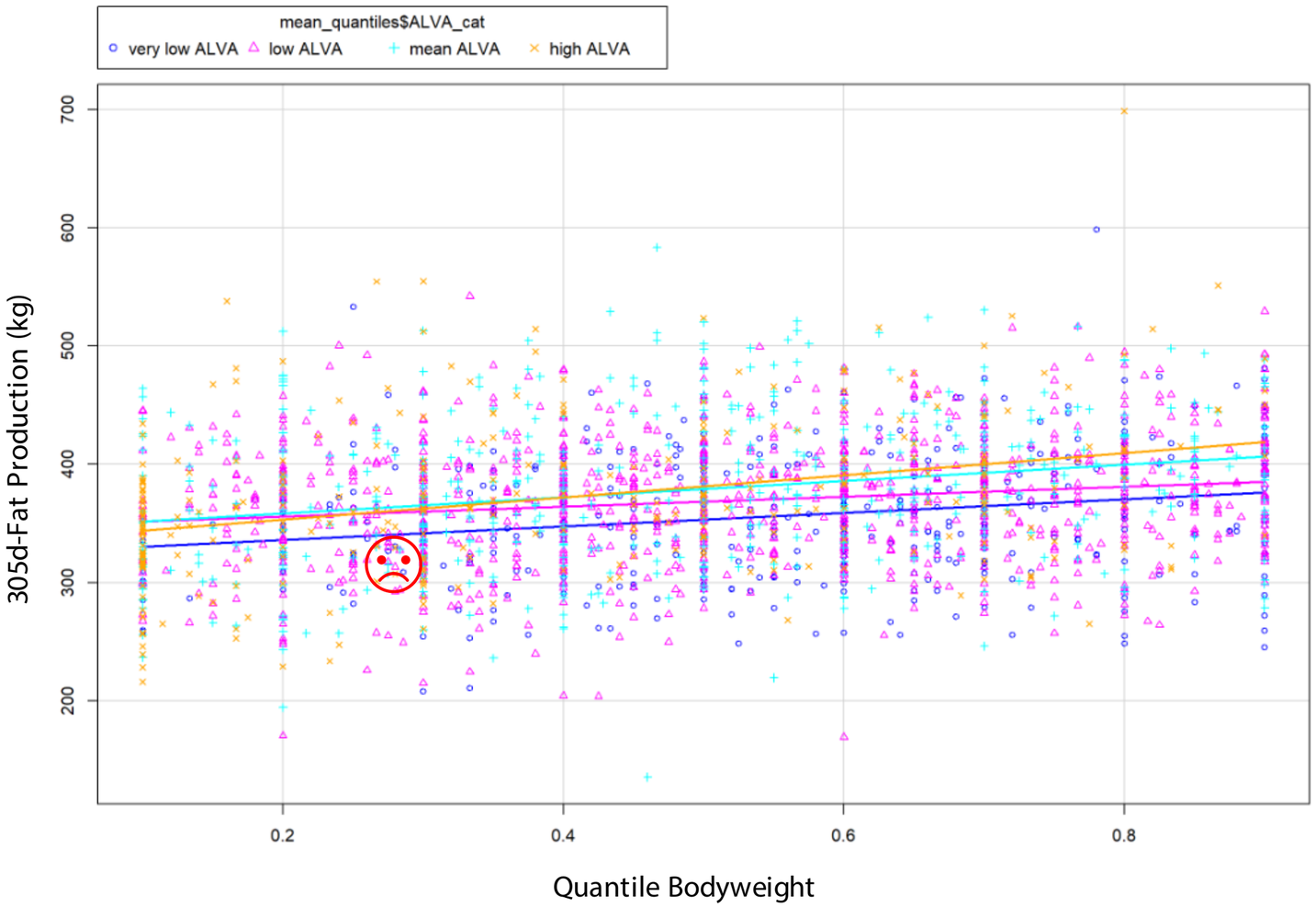
305d -Fat Production

Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	356	382	+26 kg*
Hip Height	361	378	+17 kg✧
Heart girth	362	375	+14 kg*

Least square means of the linear model, p value <0,001
*Significant interaction with **AFC category** (p<0,05), ✧ trend (p<0,10)

Very low AFC <21M	Low AFC 21 - 23M	Avg AFC 23 - 25M	High AFC >25M
+29[a]	+21[ab]	+34[ab]	+47[b]

Post hoc test (emmean), confidence level used: 0,95



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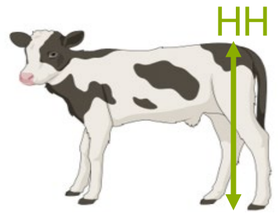
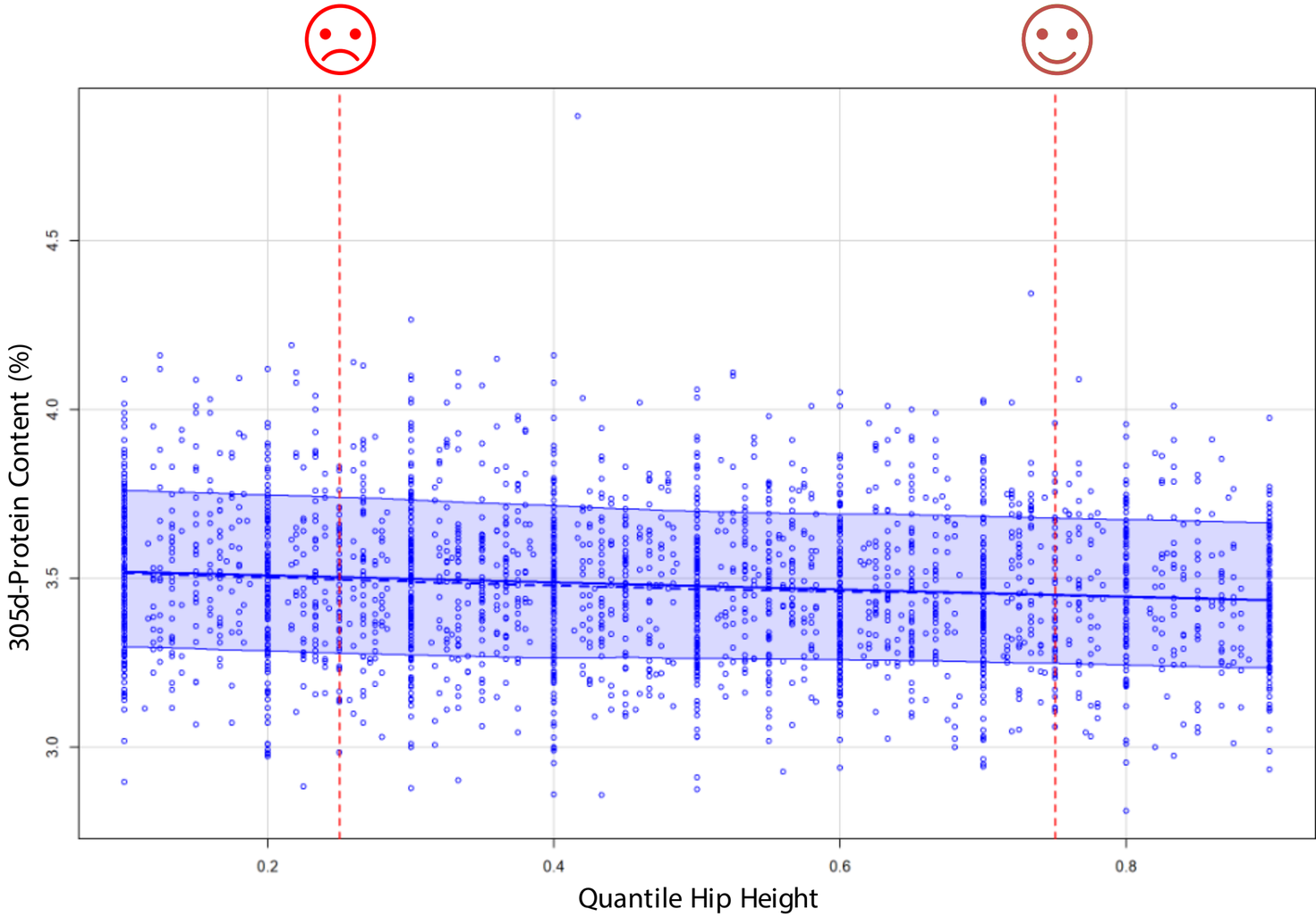
Results

305d -Protein Content

Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	3,49	3,48	NS
Hip Height	3,50	3,45	-0,05%
Heart girth	3,49	3,48	NS

Least square means of the linear model, p value <0,001





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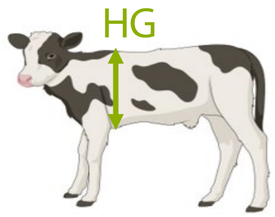


Results

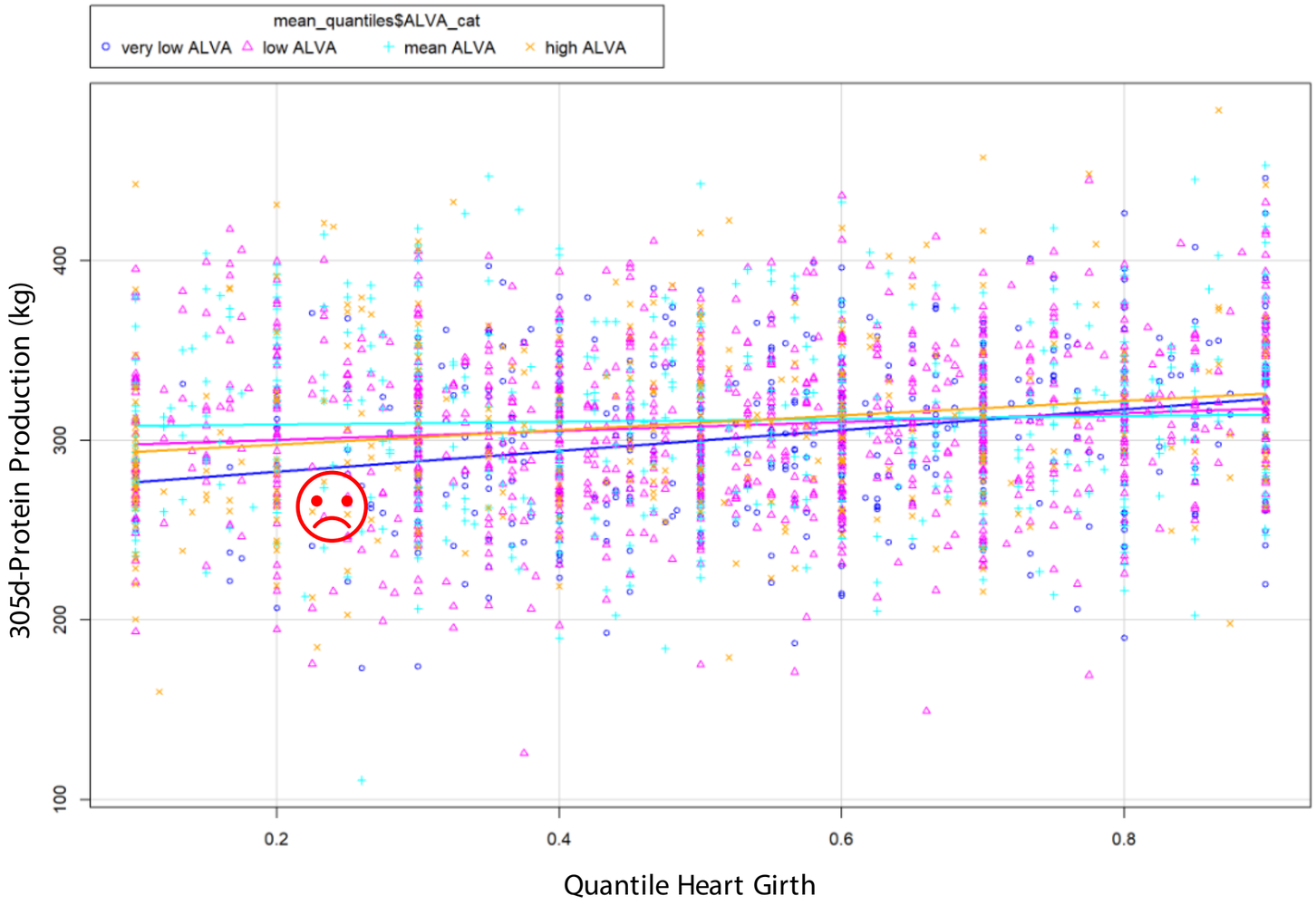
305d -Protein Production

Growth Parameter	Slow growers $Q_{0,25}$	Fast growers $Q_{0,75}$	$\Delta Q_{0,75} - Q_{0,25}$
Bodyweight	297	319	+22kg
Hip Height	301	317	+16kg
Heart girth	300	315	+15kg*

Least square means of the linear model, p value <0,001
*Significant interaction with **AFC category** (p<0,05)

Very low AFC <21M	Low AFC 21 - 23M	Avg AFC 23 - 25M	High AFC >25M
+29[a]	+12[ab]	+4[ab]	+20[b]

Post hoc test (emmean), confidence level used: 0,95



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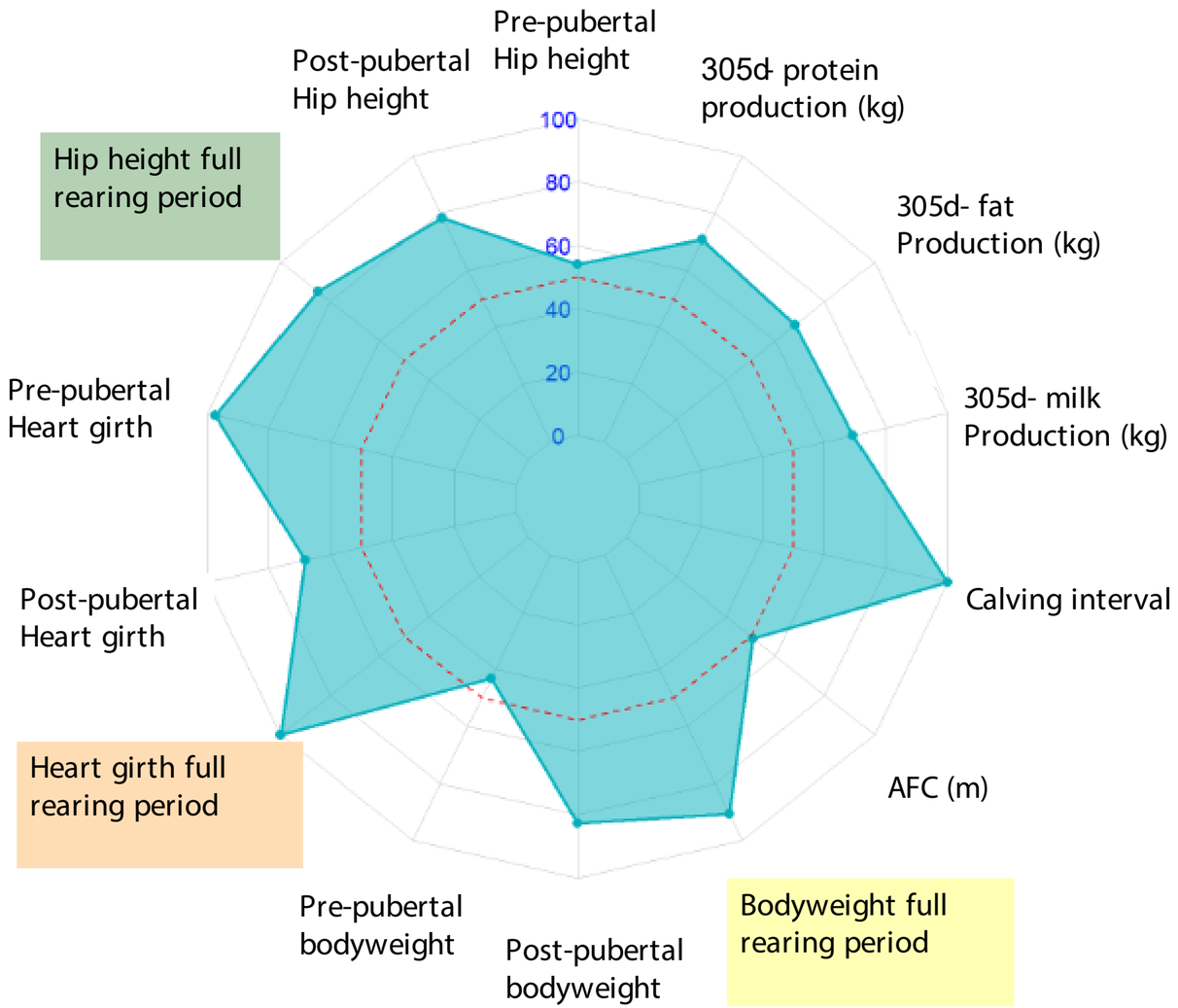
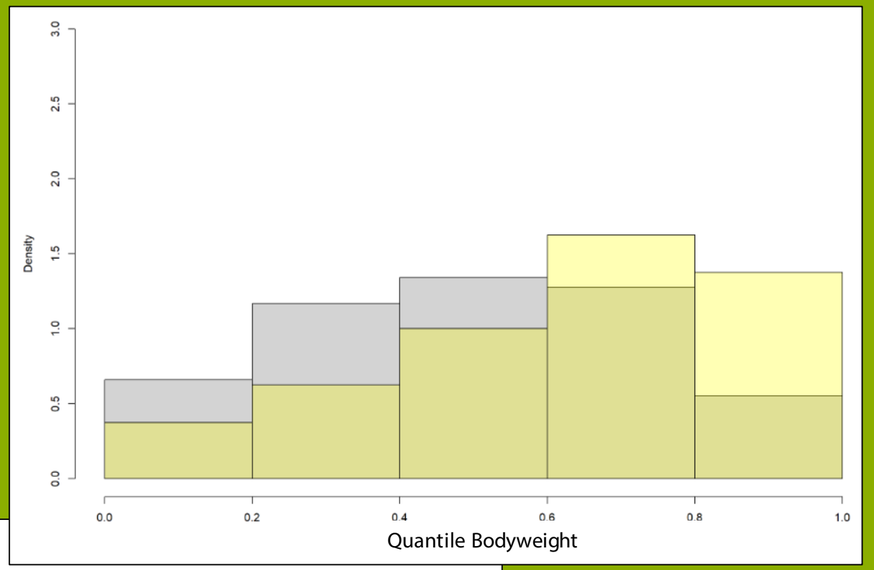
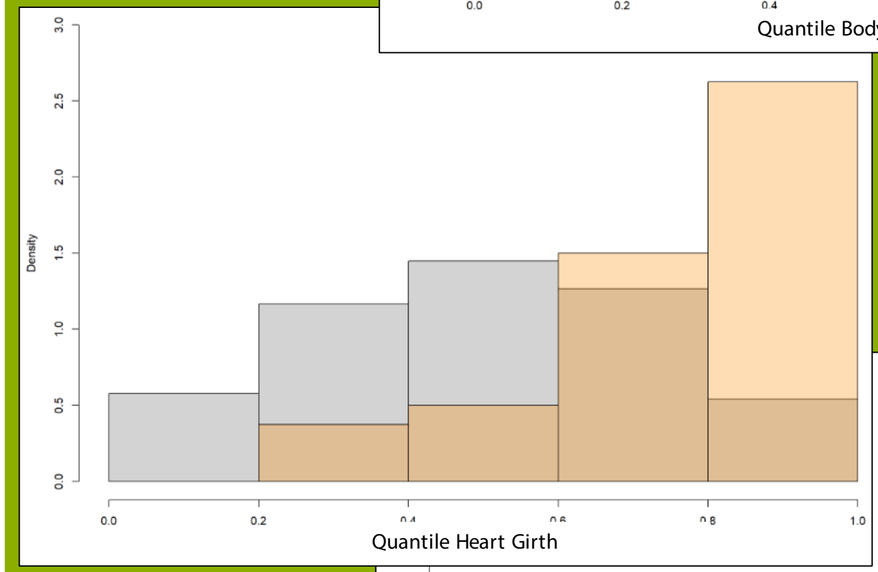
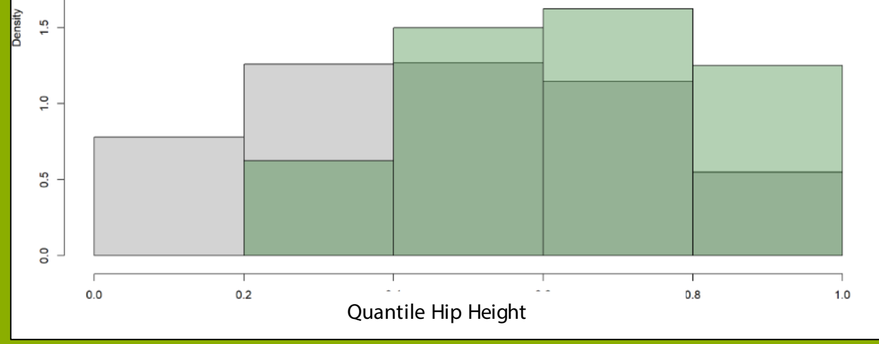
Practical use QRA on farm

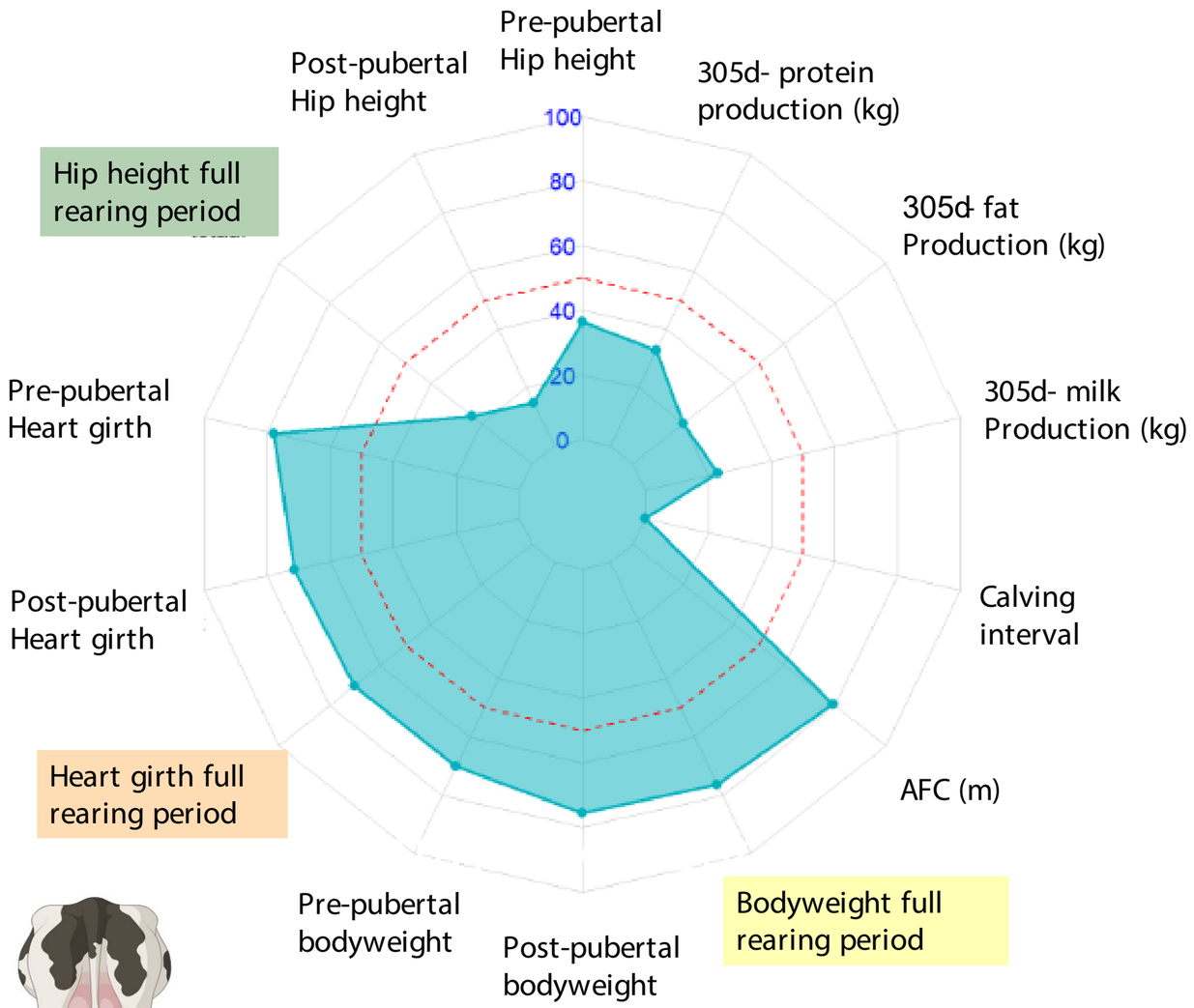


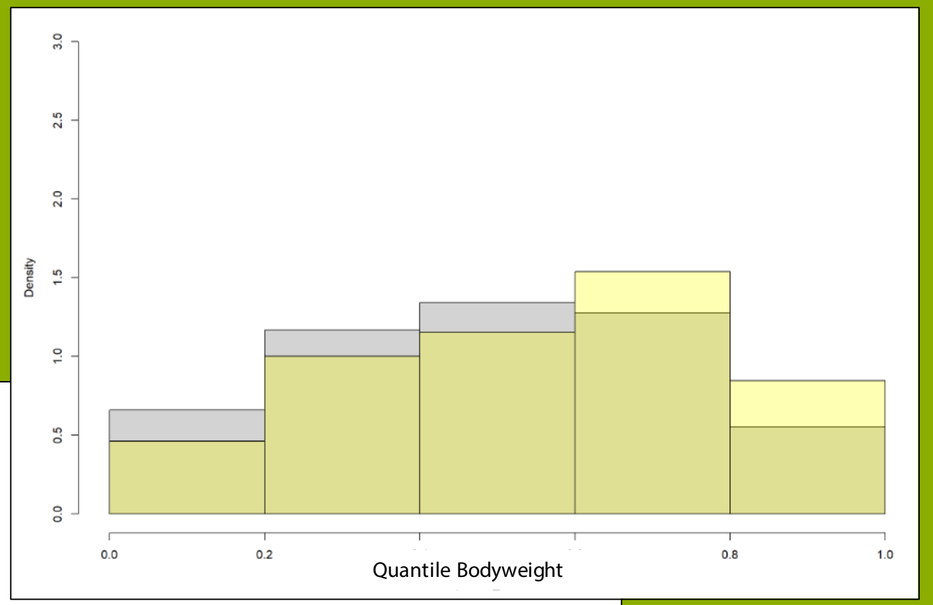


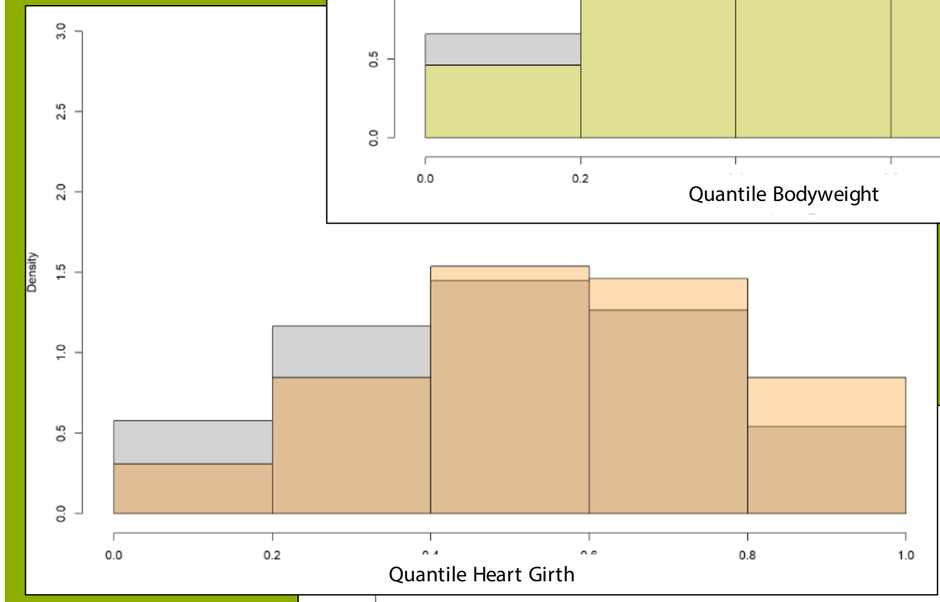


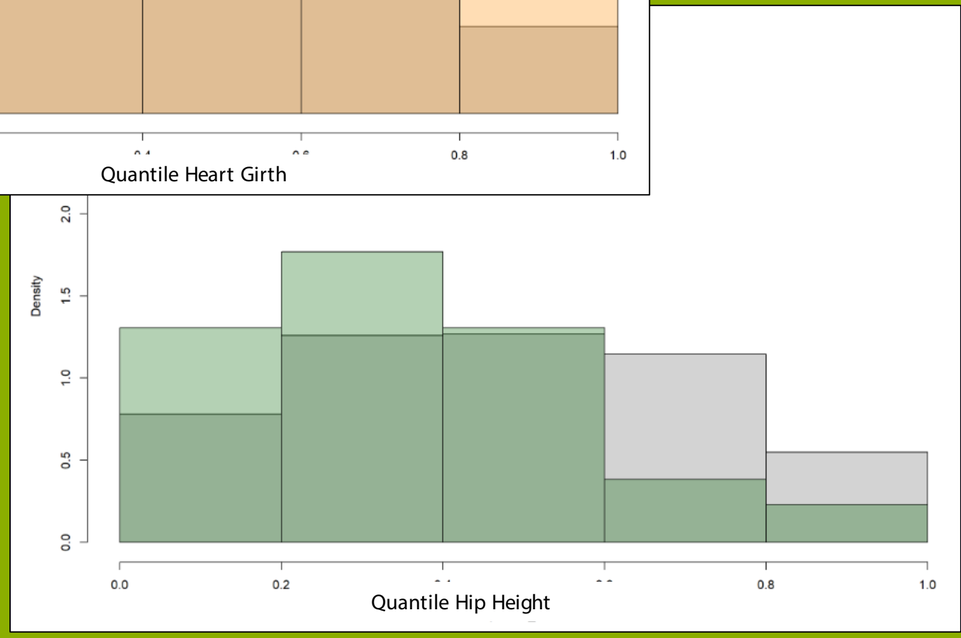


Practical use QRA on farm









Conclusions

- In comparison to slow growers, fast growers…
  - Have an earlier AFC
  - Produce ↑ milk, fat and protein yield

- Hip height was the most critical parameter according to fat and protein content

- Heart girth & Bodyweight interacted with AFC for milk, fat and protein yield
  - Parameters are management dependent
  - Weakest production for heifers with AFC <21m and slow growing

- QRA showed similar results compared to experimental settings and can be useful for growth monitoring programs on farms

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Thank you!

QUESTIONS?

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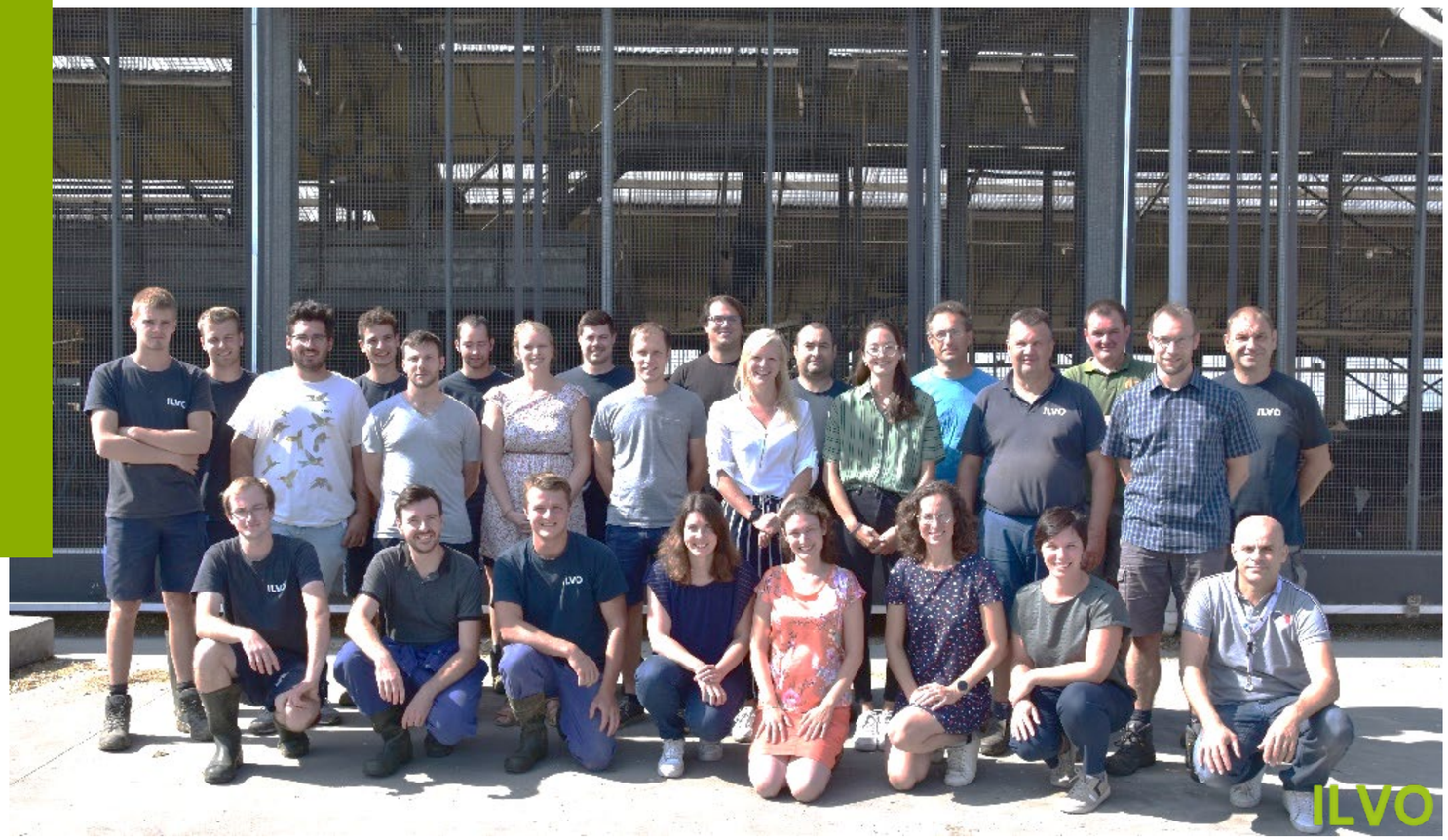

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