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Understanding the dynamic interplay between reproduction, milk production and body reserves in dairy goats: a way to optimize feeding and reproduction management

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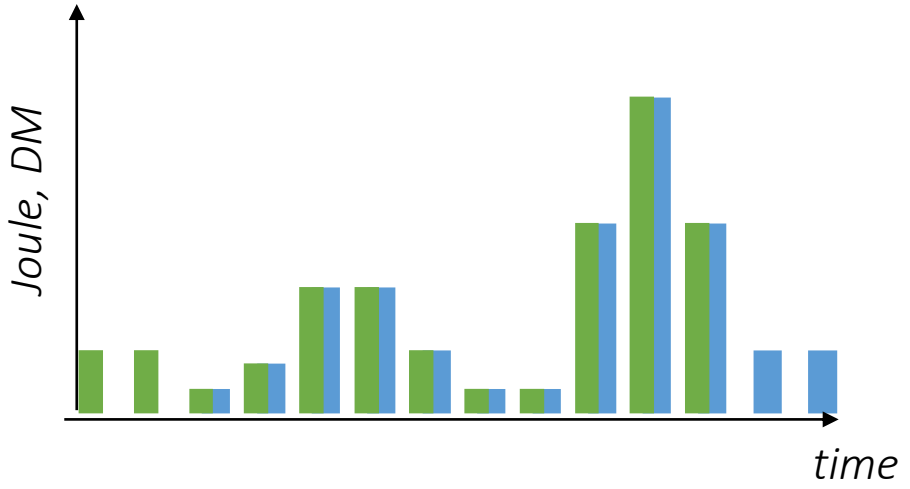
Context

Climate change

Feed offer

Herd requirement



Input = diet (x % forages, y% concentrates)

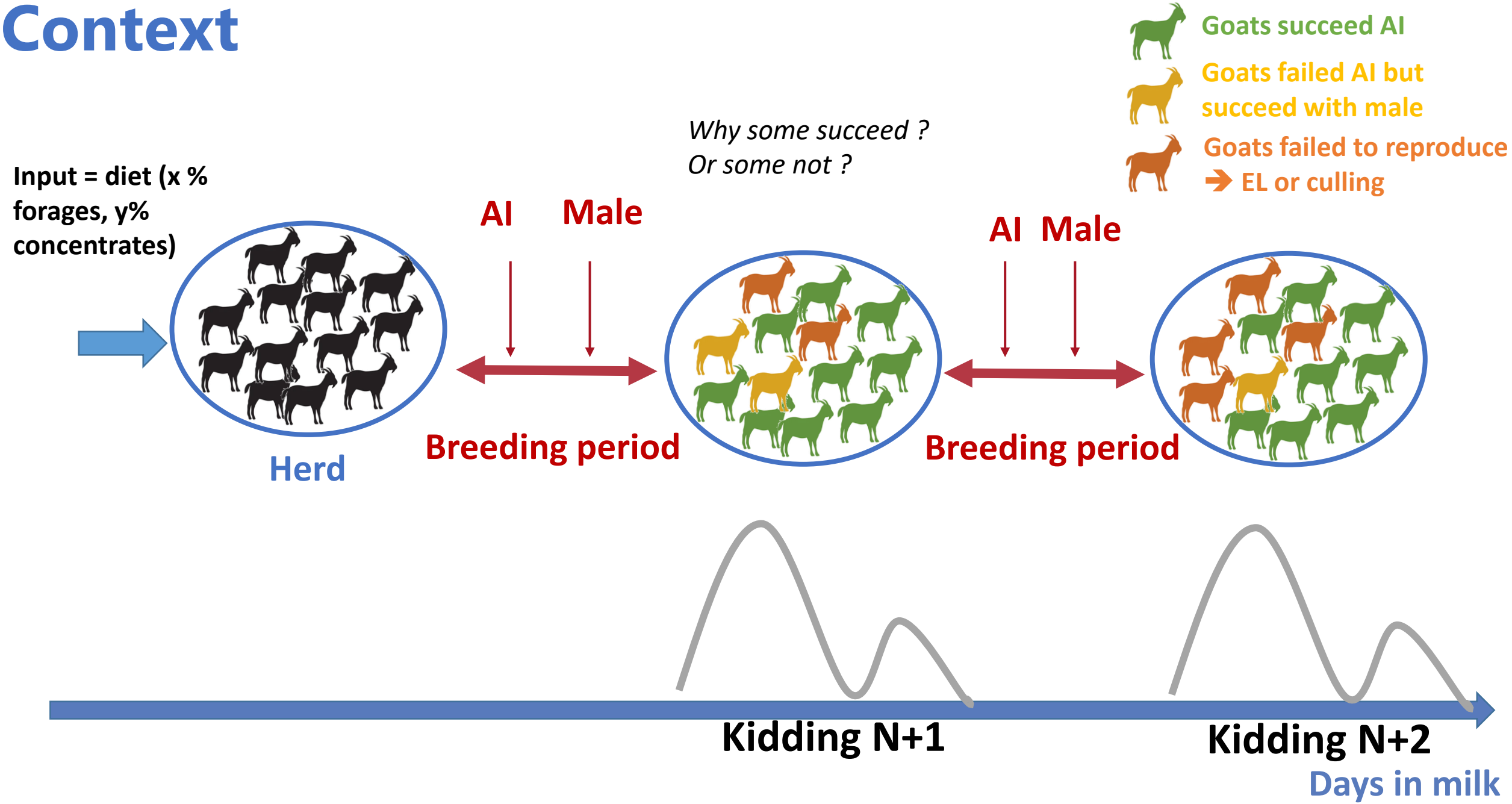
Herd

Output = milk,meat

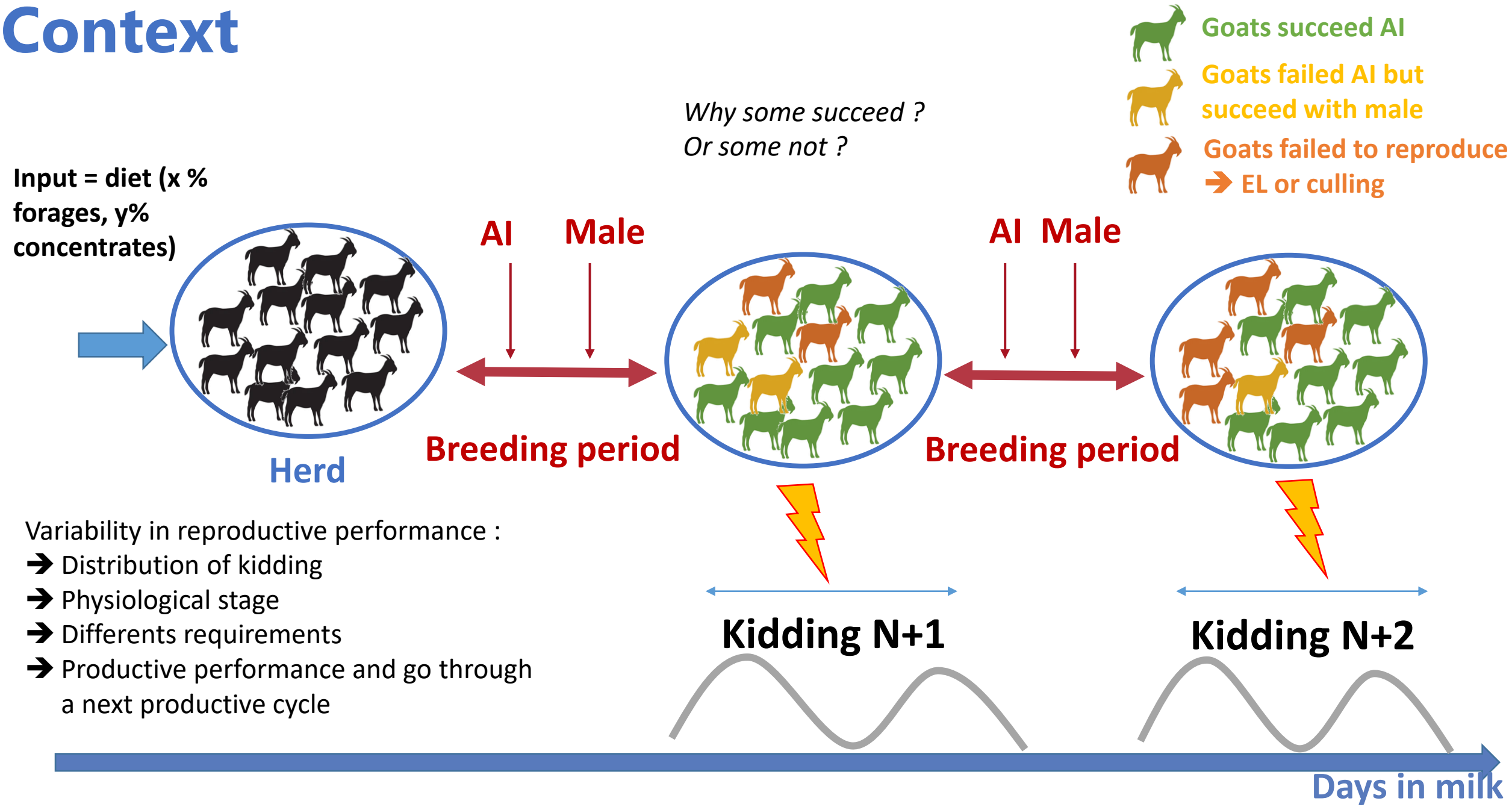
Feeding management

Reproduction management

Context


Goats succeed AI
Goats failed AI but succeed with male
Goats failed to reproduce
➔ EL or culling
Why some succeed ?
Or some not ?
Input = diet (x % forages, y% concentrates)
AI
Male
AI
Male
Herd
Breeding period
Breeding period
Kidding N+1
Kidding N+2
Days in milk

Context



Variability in reproductive performance :

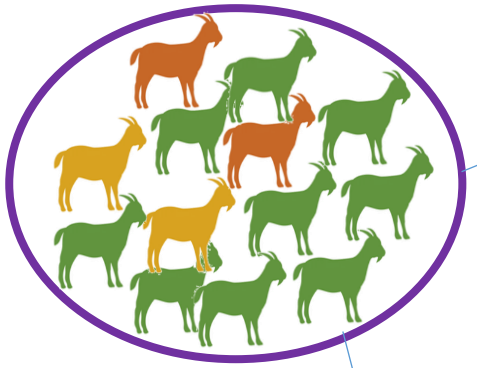
➔ Distribution of kidding

➔ Physiological stage

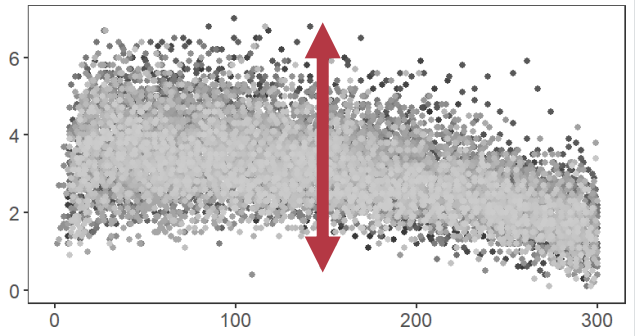
➔ Differents requirements

➔ Productive performance and go through a next productive cycle

Objective

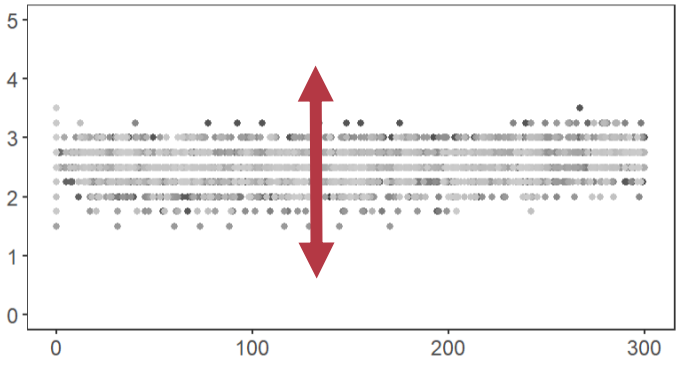


Milk yield (kg)



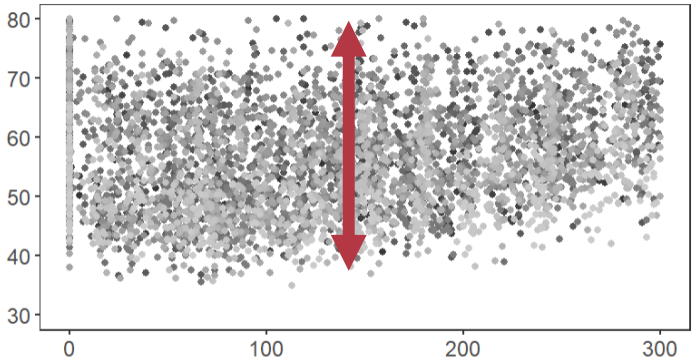
Days in milk

BCS Lumbar

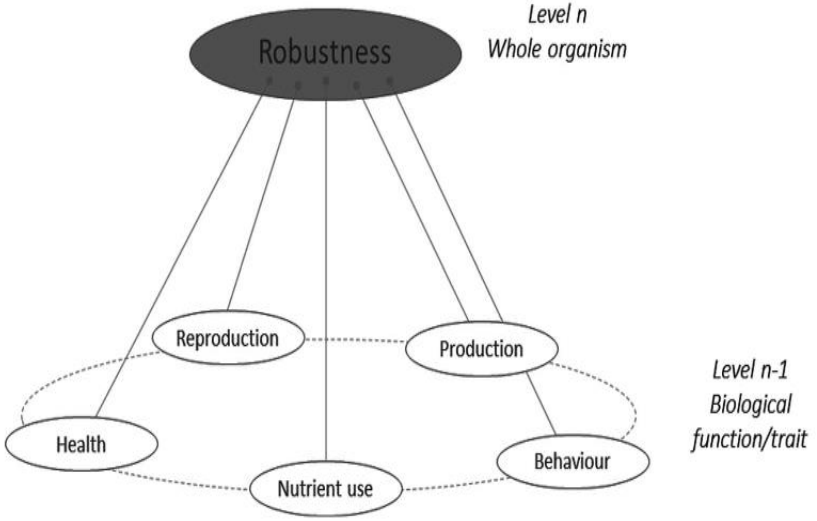


Days in milk

Body weight (kg)



Days in milk



Friggens et al.,2017

Research question :

How reproductive success (AI) is linked with milk production (MP), body weight (BW) and body condition (BCS) ?

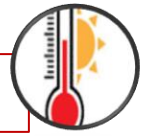
Methods : 1st approach on simple indicators

Le Pradel, French experimental farm :
595 Alpine goats (1 138 lactations) from 1996 to 2020

Goats characteristics

parity
failure at previous AI
lactation stage at AI.

Weather



T° and THI around AI.

Milk production

Body reserves

Static indicators around AI :
Milk production and quality.
BW+ BCS.

Dynamic indicators :
Δ milk production 1m before AI.
Δ body weight/condition 3m before AI.

Statistical analysis

STEP 1 : Univariate analysis

Keep variables with P value <0,2

STEP 2 : Multivariate analysis

Mixed logistical regression model with year as random effect

Forward and backward procedure = lowest AIC

Order 1 interactions were tested

Methods : 2nd approach on trajectories

Le Pradel, French experimental farm :
292 Alpine goats (380 lactations) from 1996 to 2020

Goats characteristics

parity
failure at previous AI
lactation stage at AI.

Weather

Temperature and THI around AI.

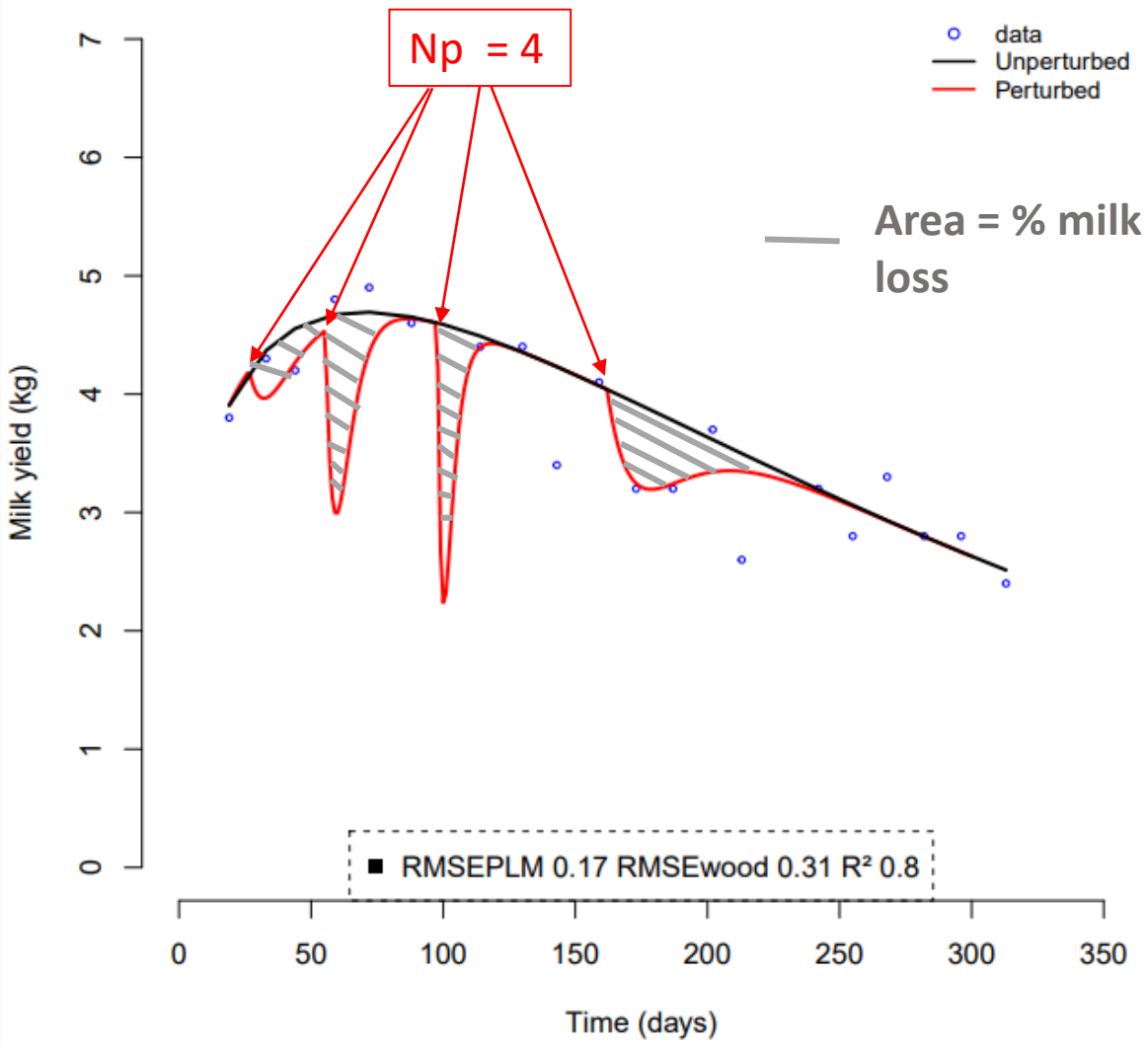
Milk production

Body reserves

Modelling trajectory :
Perturbed lactation model (PLM) (Benabdelkrim et al.,2021)

Perturbed curve (Number of perturbation (Np), % Milk loss)

Wood model (Wood,1967) : a, b ,c



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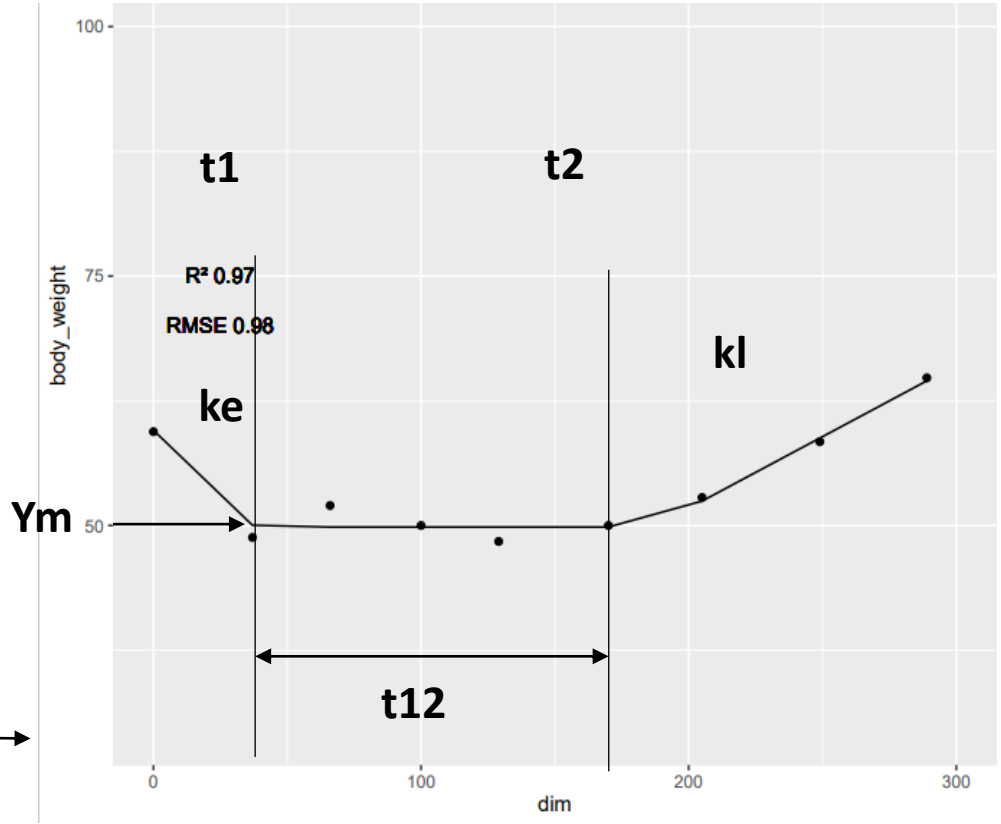
Milk production

Body reserves

Modelling trajectory :
Perturbated lactation model
(Benabdelkrim et al.,2021)

Modelling trajectory :
Grossman et al., 1999 model



Ym = minimum of body weight/body condition

ke = speed body weight/body condition loss

kl = speed body weight/body condition gain

t1 = time where Ym reached

t2 = time where the gain begins

Methods : 2nd approach on trajectories

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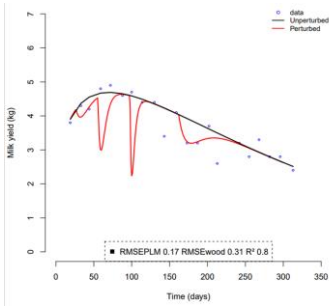
Temperature and THI around AI.

Milk production

Body reserves

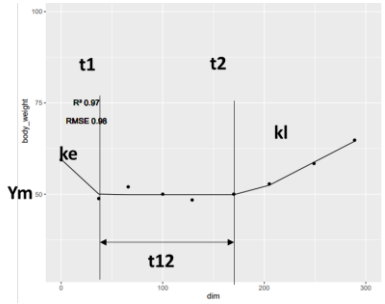
Each trajectory (MP, BW, BCS) has its own parameters !

Modelling trajectory :
Perturbated lactation model
(Benabdelkrim et al.,2021)



5 parameters (a, b, c, Np, %milk loss)

Modelling trajectory :
Grossman et al., 1999 model



5 parameters (Ym, ke, kl, t1, t2) x 3

Methods : 2nd approach on trajectories

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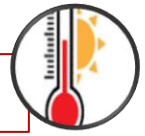
Weather



Temperature and THI around AI.

Body reserves

Modelling trajectory :
Grossman et al., 1999 model

STEP 1 : Evaluation goodness of fit :
Root Mean Square Error (RMSE)

STEP 2 : Univariate analysis

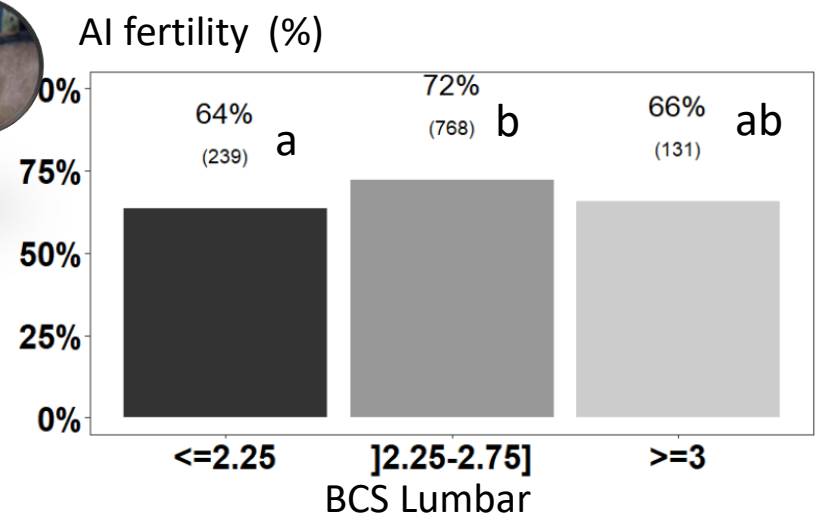
STEP 3 : Multivariate analysis

Results : 1st approach on simple indicators

Significant indicators (P-value <0,05)

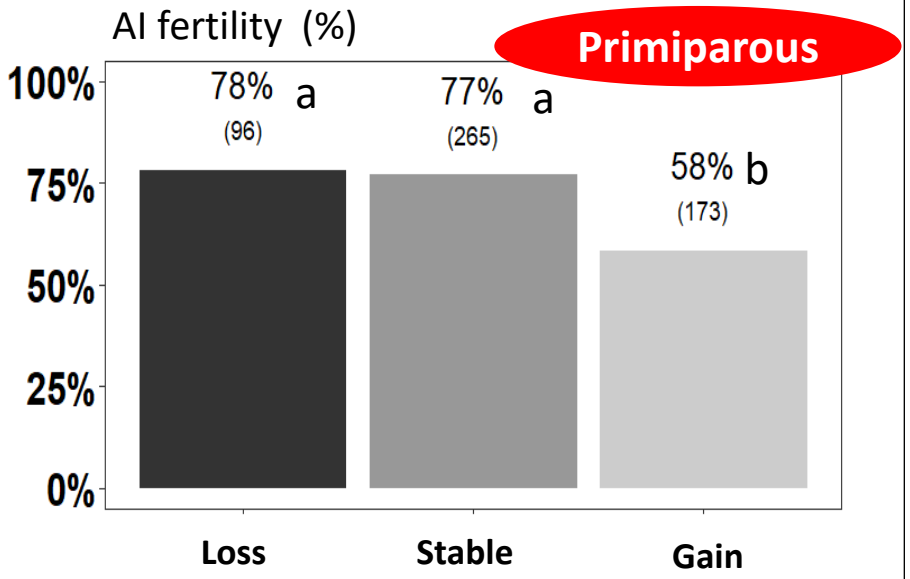
Body reserves

Good to be not to thin and not to fat !



Primiparous

Lumbar gain not good for AI success

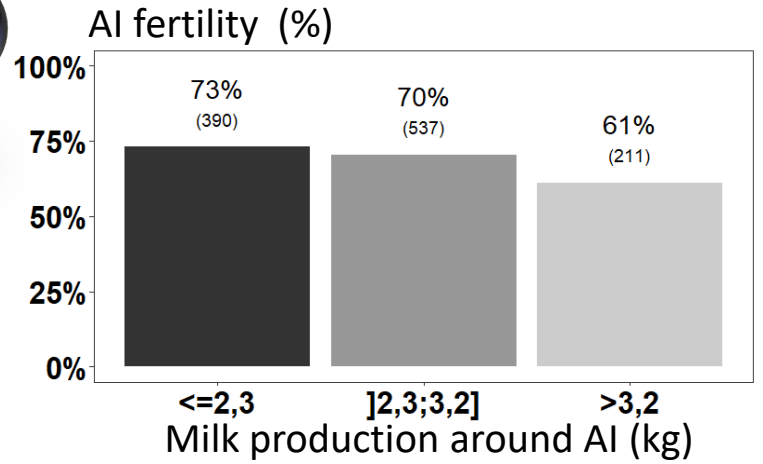


Tendencies (0,05 < P-value < 0,10)

Milk production

Just a tendency, but consistent with literature

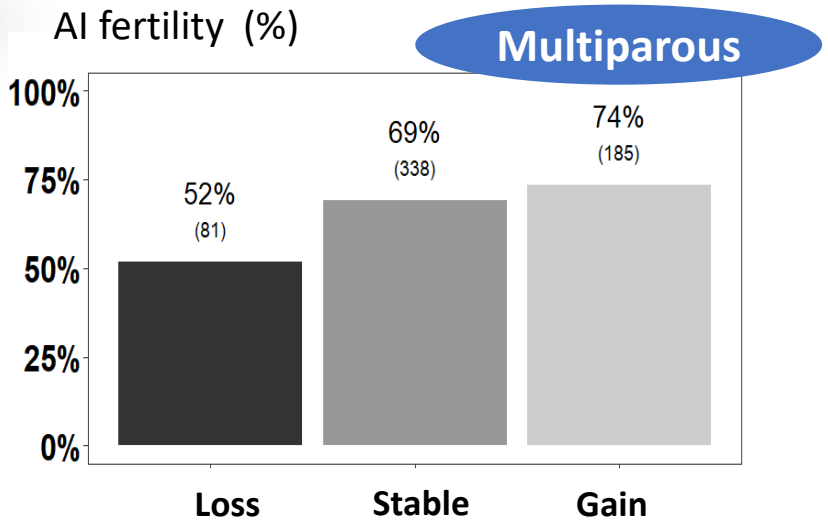
(Arrebola et al., 2014; Freret et al., 2018)



Body reserves

Sternal gain good for AI success

Multiparous

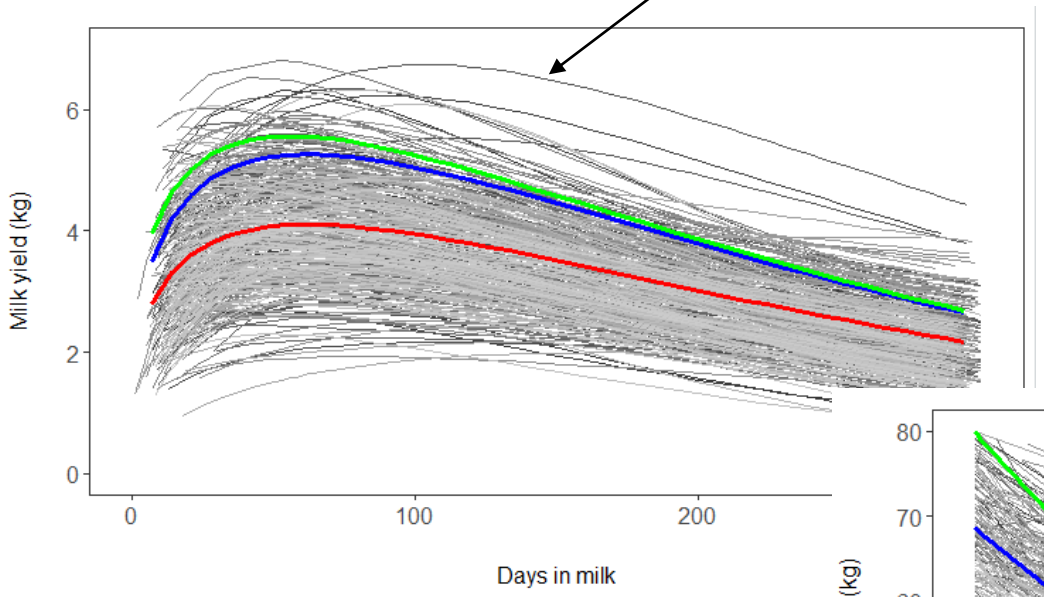


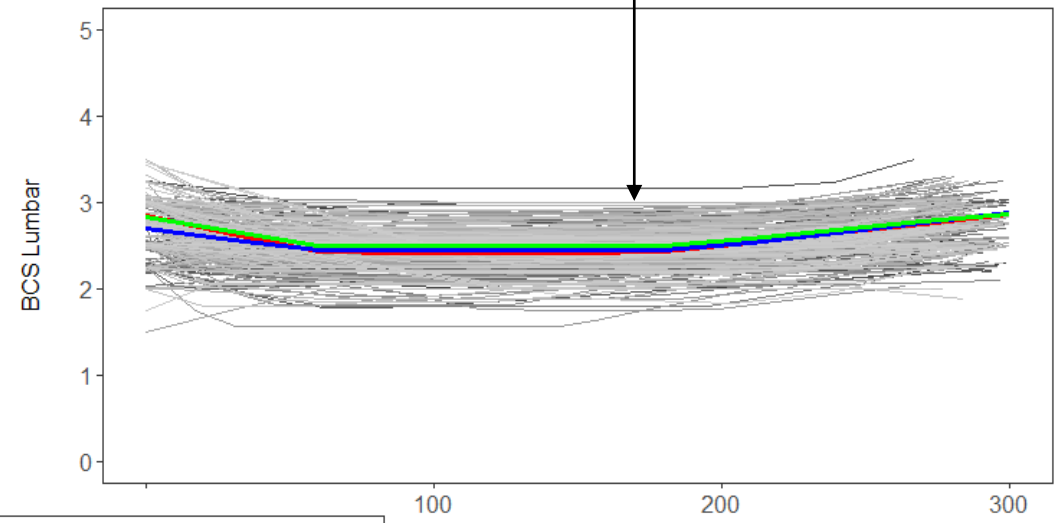
Results : 2nd approach on trajectories Characteristics

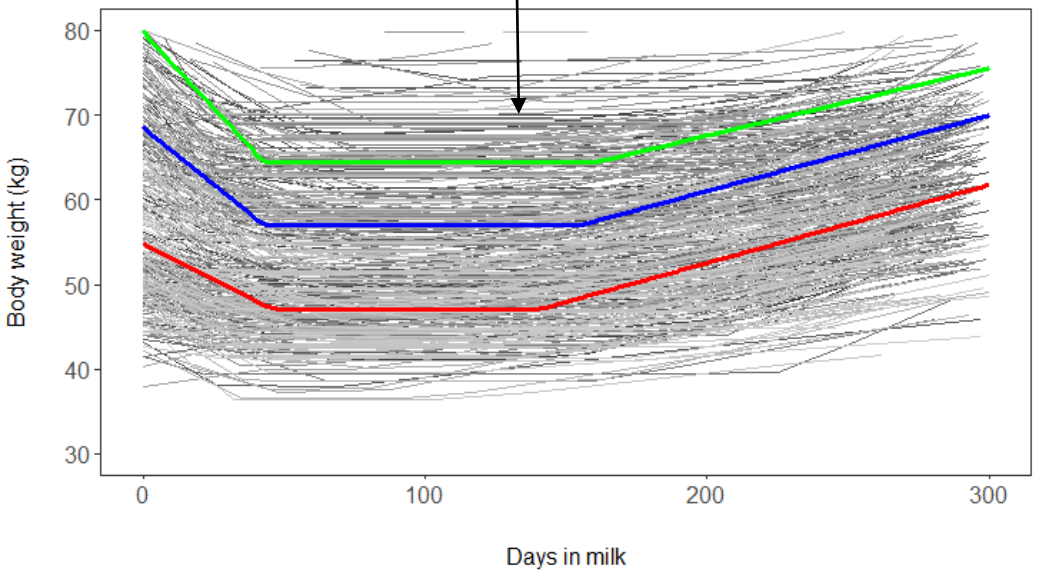
P(AI success) = α1 * lactation stage at AI + α2 * parity + α3 * kl + α4 * BWm + α5 * t1 + α6 * BCS_Lm + α7 * t12_BCS_L +

α8 * kl_BCS_S + α9 * ke_BCS_S + α10 * c

Sternal | Body weight | Lumbar | Milk





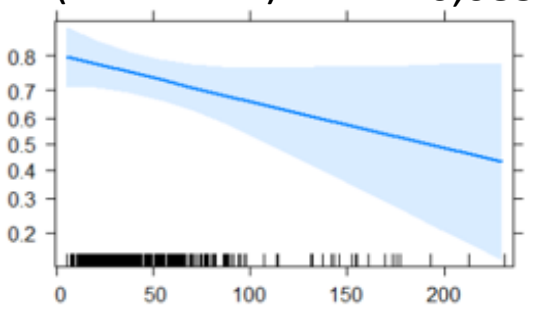


Parity
1
2
3+

One lactation trajectory

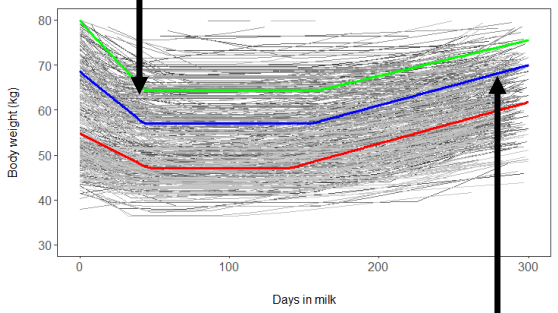
Results : 2nd approach on trajectories

P(AI success) P=0,085

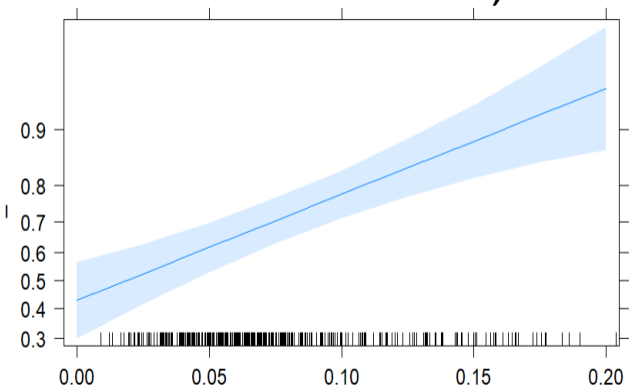


t1

Longer BW loss➔ decrease AI success



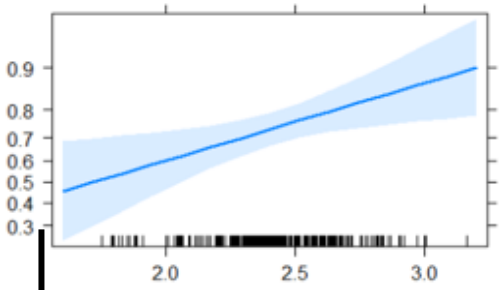
P(AI success) P<0,001



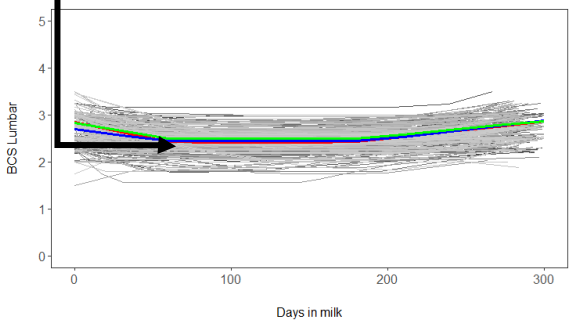
kl

Faster BW gain ➔ better AI success

P(AI success) P=0,009

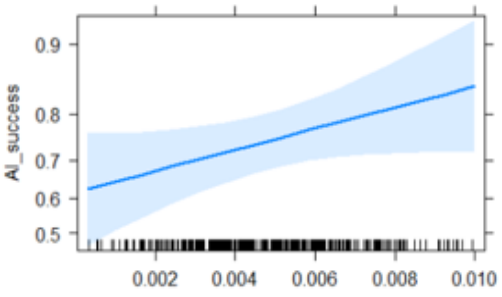


Lm

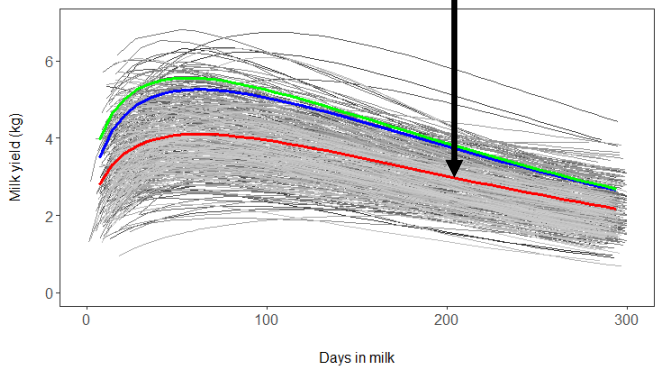


Higher min BCS lumbar ➔ better AI success

P(AI success) P=0,063



c



Lower persistency ➔better AI success

Take home message

- Two complementary approaches for predicting reproductive success:

- Effect of BCS Lumbar level on AI fertility

- Dynamic of performance matters, especially with BW(t1 and kl) and milk (c) parameters

➔ Select goats for reproduction and prevent reproductive disorders
➔ Target goats that needs specific feeding management
➔ Monitor animals during whole lactation → have enough information to decide culling/extended lactation

Perspective

- A first explanatory trajectory approach ➔ consolidated with another database

➔ Better characterizing individual trajectories to find the best ones that minimize risks of reproductive failure

➔ Could help to select more resilient animals = able to cope with available resources

Thank you for your attention !