Resources allocation in reproductive rabbit does: genetic strategies for a suitable performance

Pascual J.J., Cervera C., Baselga M.

Institute for Animal Science and Technology

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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FIERA DI FORLI'
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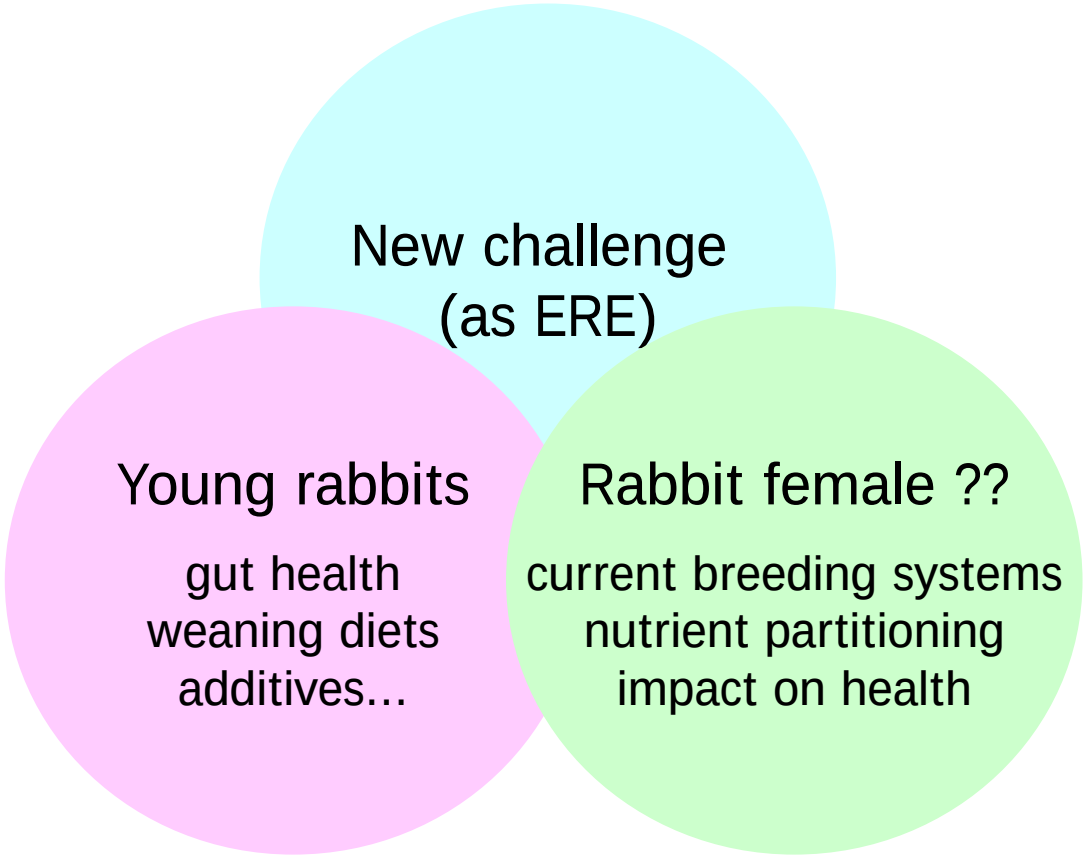
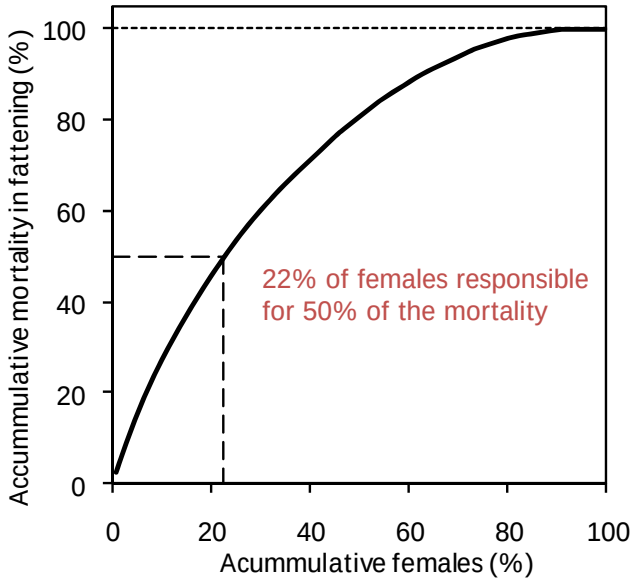
Rabbit health

“main handicap of the current rabbit farming”



Litter effect on digestive troubles

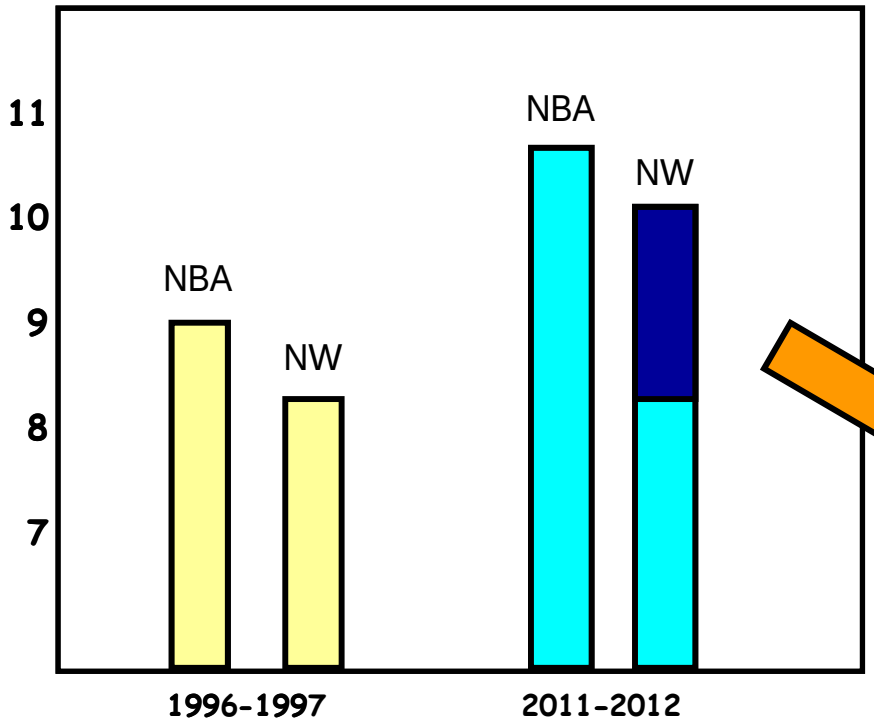


Quevedo *et al.*, 2003

“Global health and welfare of the farm”

Genetic selection programmes

"Selection for litter size"



"Selection for growth rate"

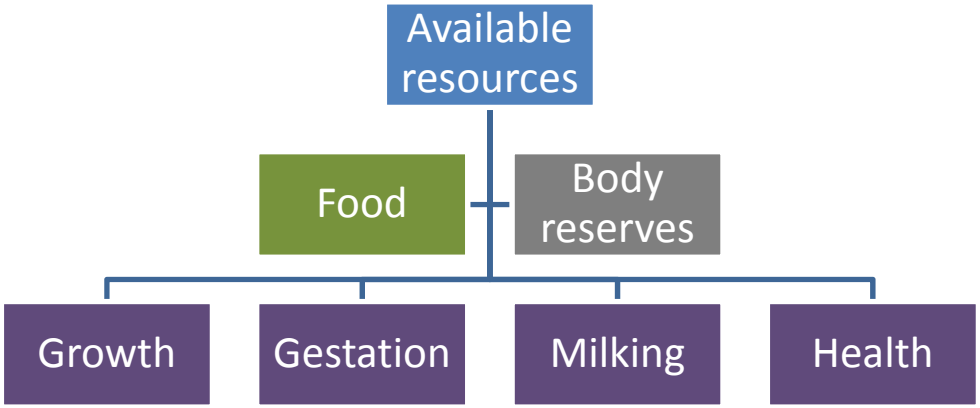
New reproductive management

↑↑ *female requirements*

Changes in nutrient partitioning ?

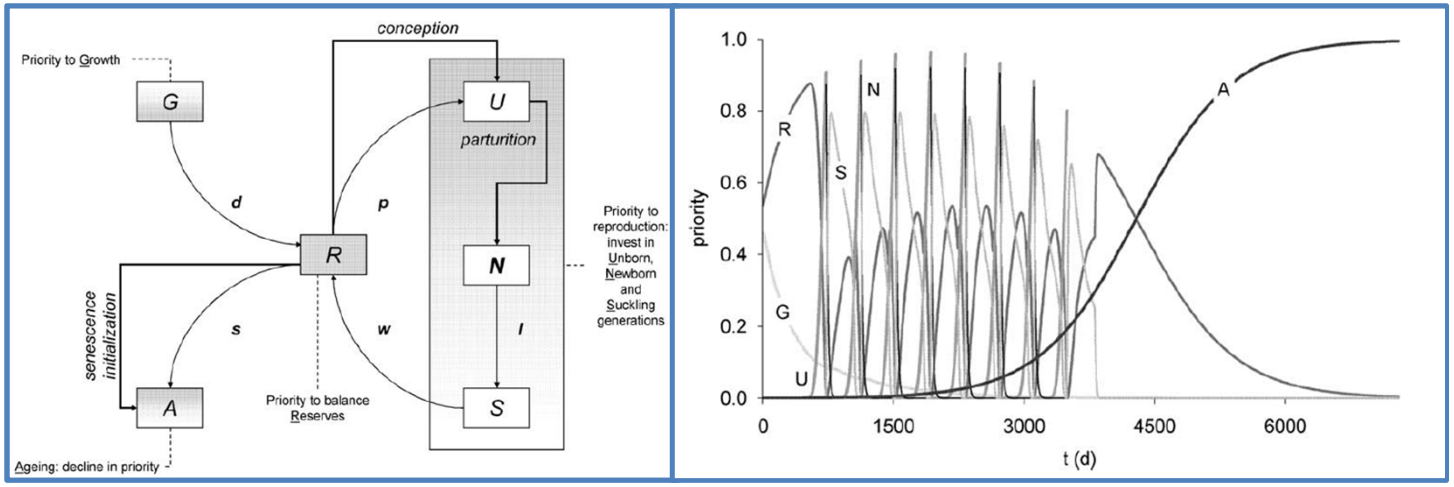
lifespan and farm health compromised ?

Nutrient partitioning



"Changes in the proportions addressed to each of them with the physiological state and age"

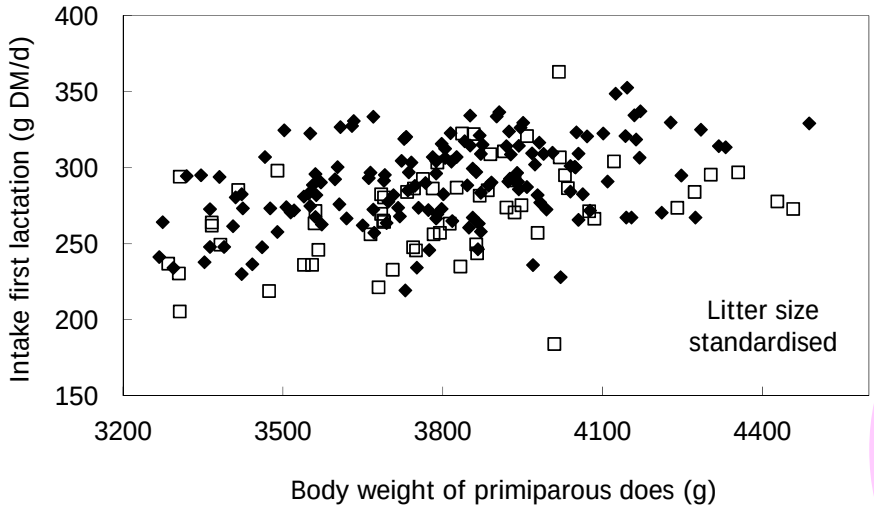
Relative priorities of the female change (GARUNS: Martin and Sauvant, 2010)



"Resources allocation and body condition seems to be genetically driven"

Independence resources-mobilisation

Primiparous ⇒ low body size ⇒ limited intake



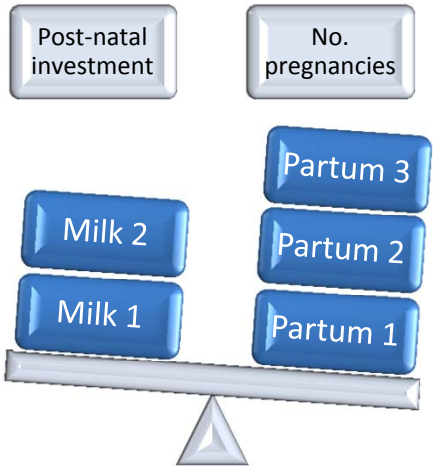
Punctual negative balances

≠ malfunctioning of animal

= natural adaptation ensure evolutionary success

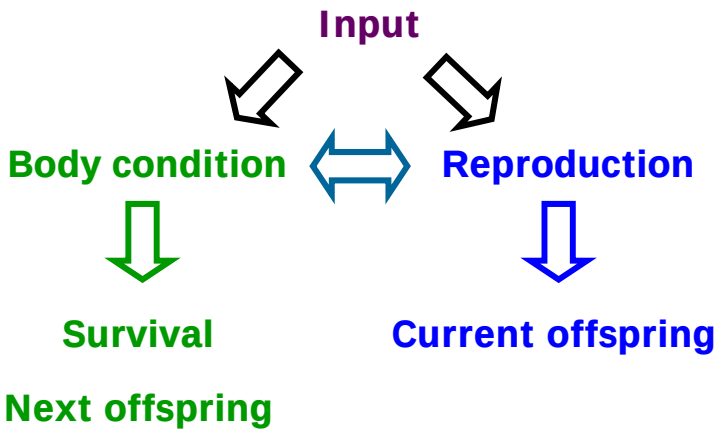
Rabbits:

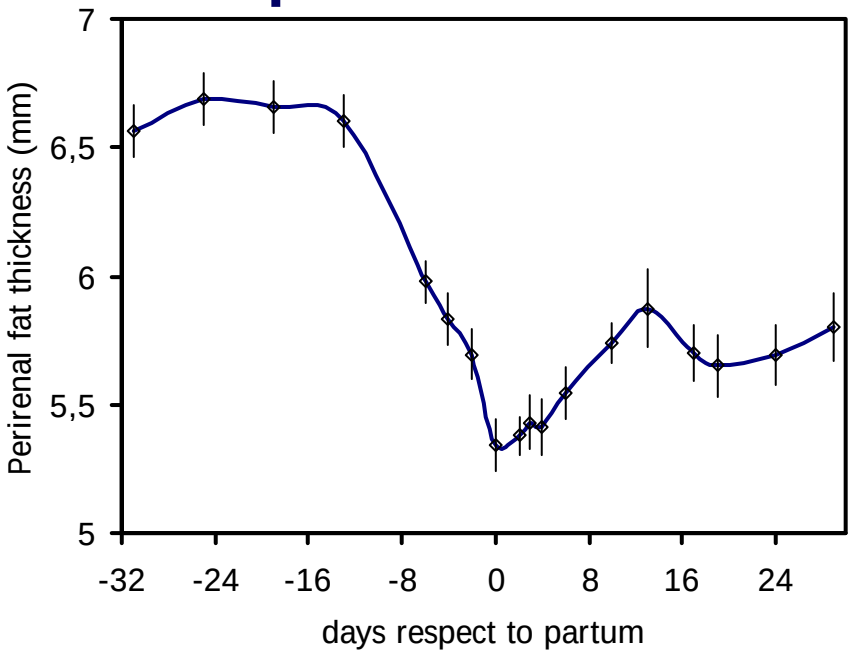
Success of selection for litter size



"How rearing, feeding and selection is affecting nutrient partitioning, and so reproduction and lifespan?"

Body condition and reproduction

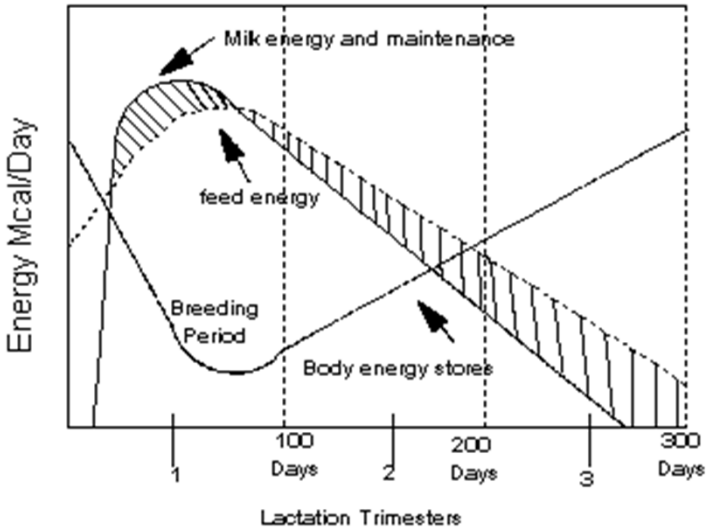




"Enough evidence of a genetic component driving body fatness"

Body condition evolution:

- Maximum aprox. 10 d before kindling
- Minimum around kindling
- Recovery after parturition

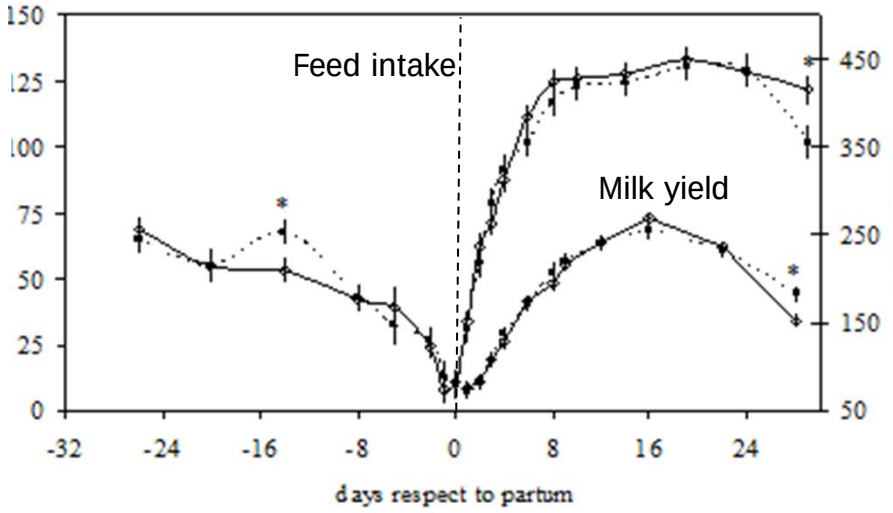


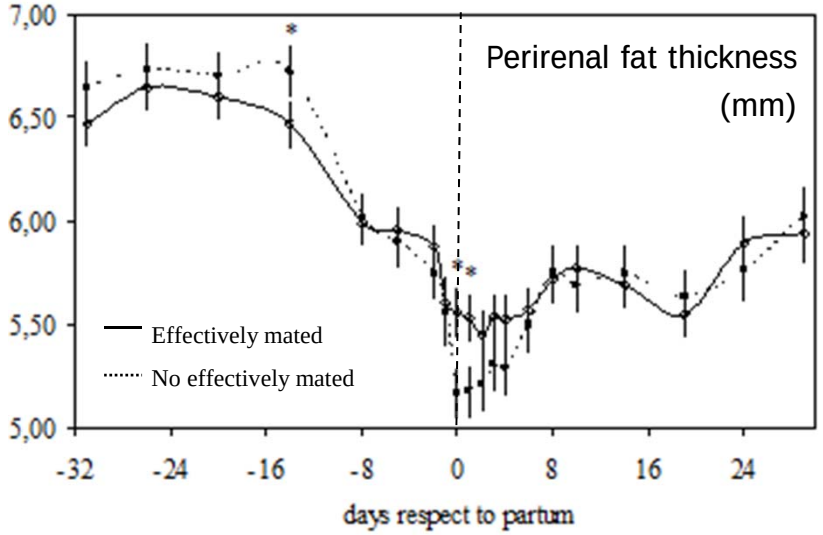
"This course of the body reserves is slightly different from other species"

Results in vivo (PFT, TOBEC and BIAS)

Body condition and reproduction

Savietto, 2012





Evolutionary success of rabbits, “the number”:

- Fertile acceptance at postpartum
- Early lactation recovery: feed slope > milk slope

Relevance of body condition around kindling:

- Quevedo *et al.,* 2006b:

↑ Pre-partum losses

⇩ r = + 0.29 ***

↑ Post-partum recovery

⇩

↓ Post-partum fertility

Females that were not effectively AI at 11 d

–PFT losses in late pregnancy,

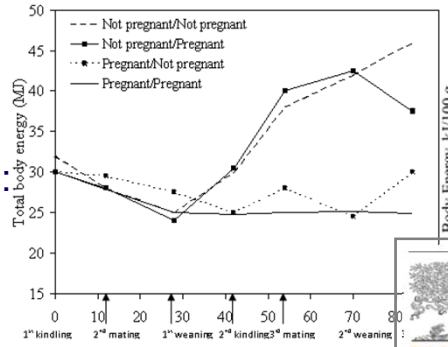
↓ PFT at partum and ↑ recovery in early lactation

Body condition and reproduction

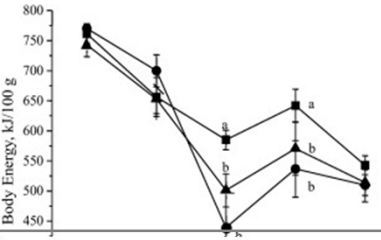
Negative balance during lactation??

- Primiparous, sometimes !!
- Multiparous, no relevant !!
- Lactation-gestation concurrence:
  - lower milk and recovery
  - but less recovery time

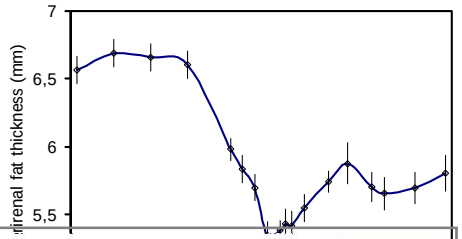
TOBEC



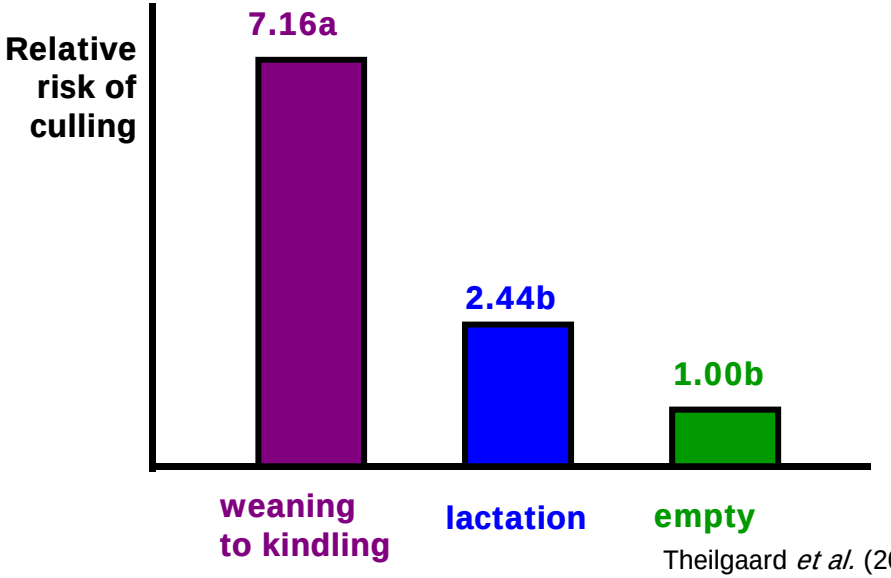
BIAS



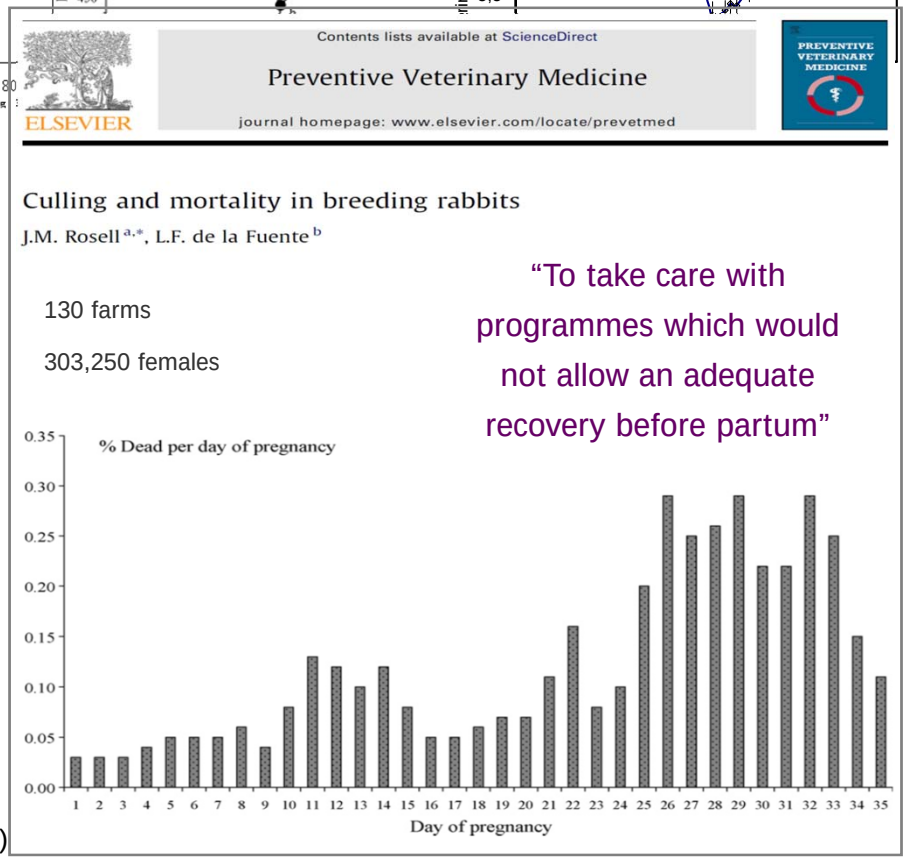
PFT



Main risk of imbalance in late pregnancy!!

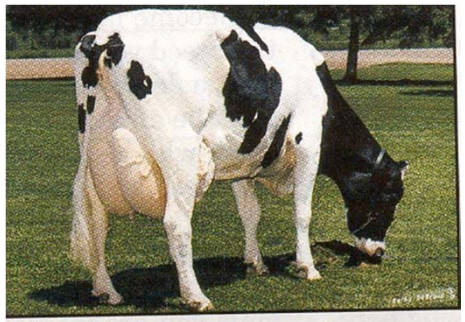


Theilgaard *et al.* (2006)



Genetic selection and resource allocation

Genetic selection in livestock: ↑ Productive level



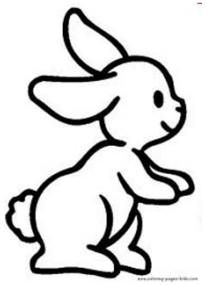
Muranda Oscar Lucinda

30870 kg in 365 d (85 kg/d)

Negative associated effects: + ↓ fertility

+ ↑ incidence of metabolic diseases

+ ↓ viability of the offspring



Rabbit does: + 125% replacement

+ ↑ health problems (mainly digestive)

"How is genetic selection affecting resources allocation?"

Selection for growth rate (GR)

↑ **GR:** ↑ Feed intake and ↓ FCR

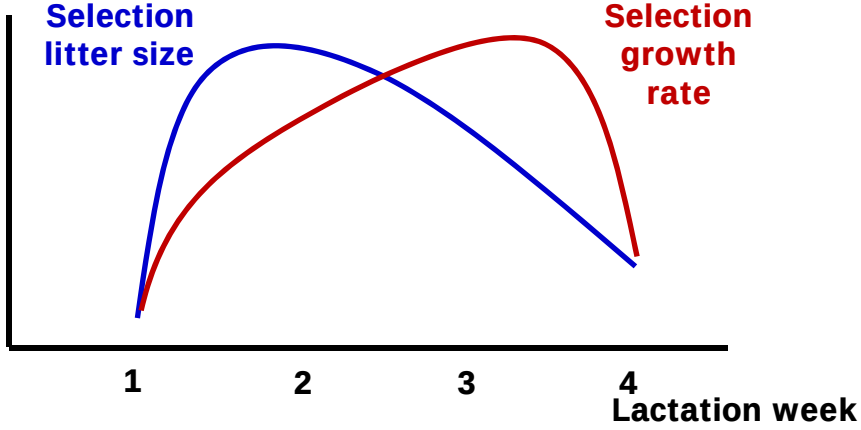
↑ Tendency to **excessive fatness**

↓ **Fertility and litter size** (Castellini *et al.*, 2006)

↑ **Abnormal spermatozoa** (Du Plessis *et al.*, 2010)

More research is needed

↓ **Lifespan** (Theilgaard et al., 2006)



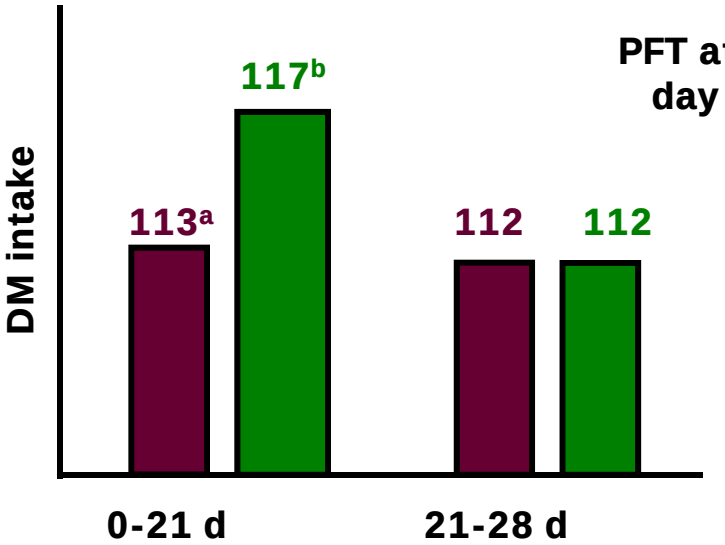
Selection for litter size

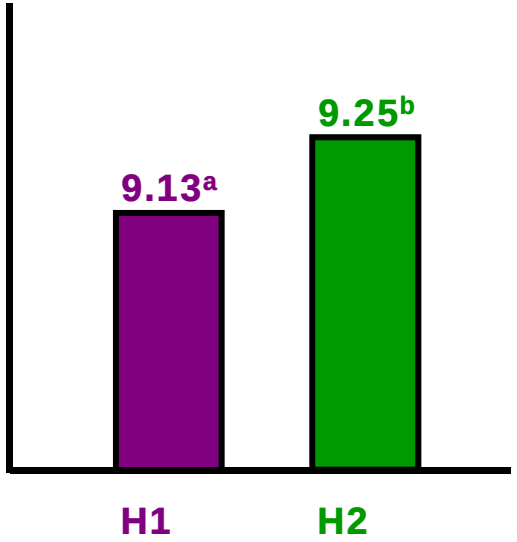
Antagonism reproduction - survival

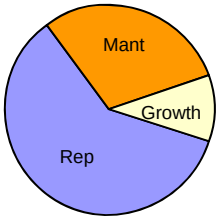
Quevedo *et al.*, 2006

♀ line V (15th gener.) x ♂ line A (16th gener.) → ♀ H1

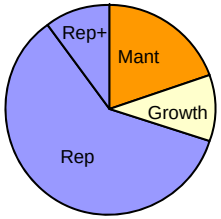
♀ line V (26th gener.) x ♂ line A (31st gener.) → ♀ H2

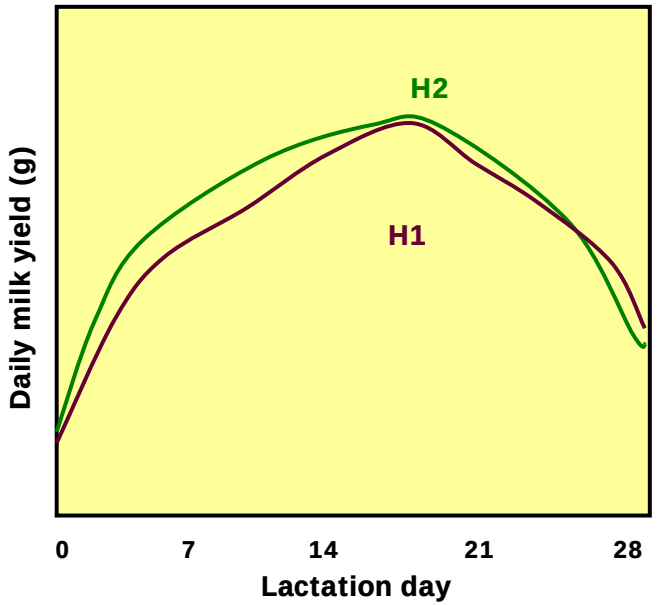


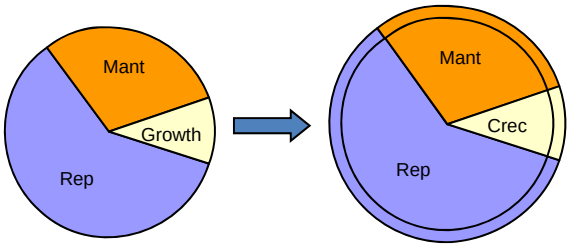




Survival??



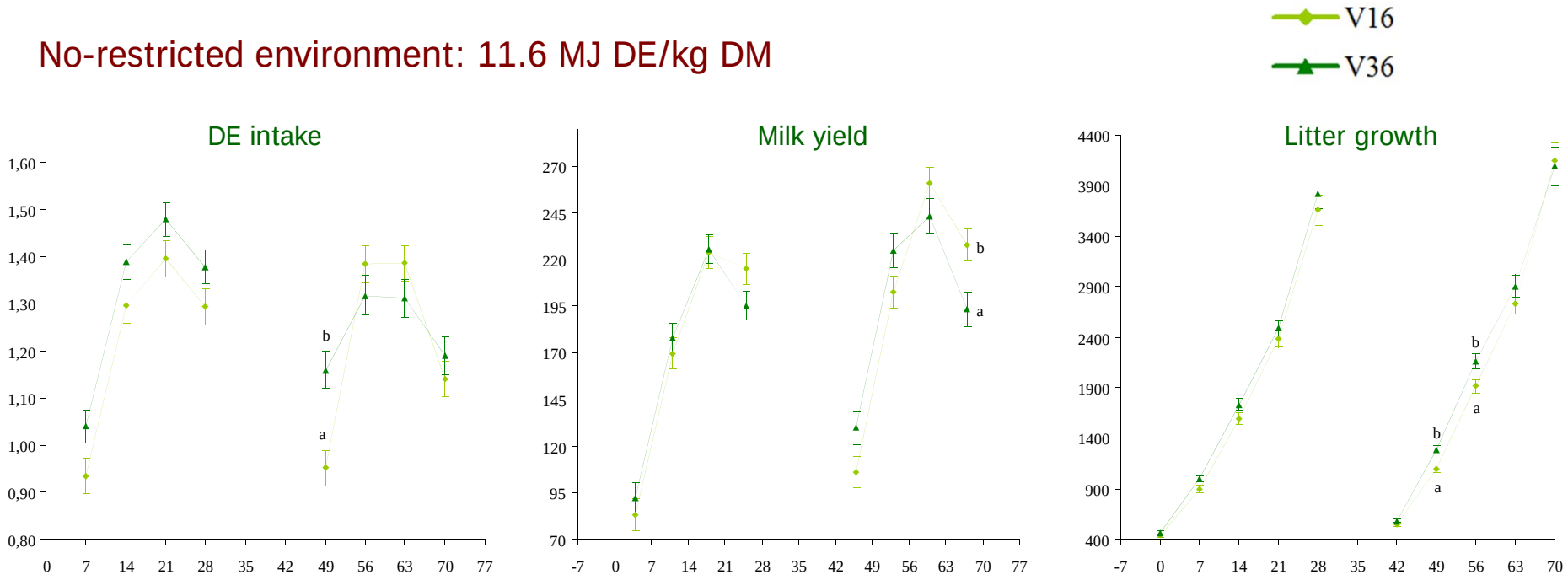




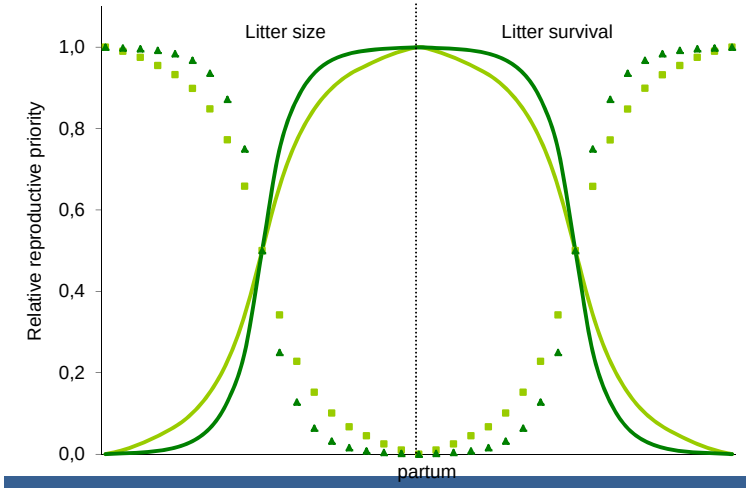
"Selection for litter size at weaning has increased female capacity to obtain resources"

Selection for litter size

No-restricted environment: 11.6 MJ DE/kg DM



Friggens, 2003



In no-restricted conditions selection for litter size:

+ ↑ pre-partum effort (litter size)

+ ↑ post-partum milk (litter survival)

Selection for litter size at weaning:

Changes in nutrient partitioning addressed to ensure its evolutionary success

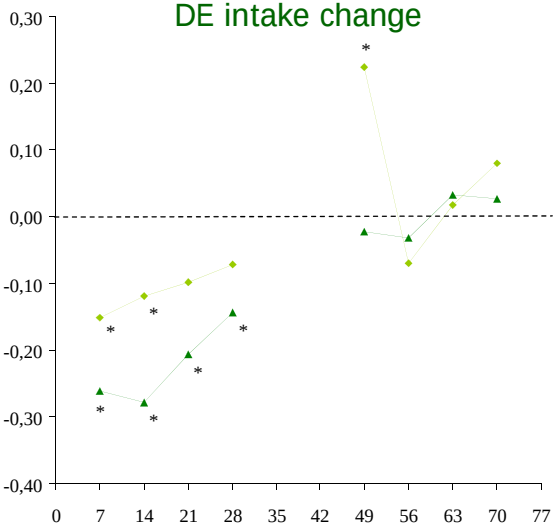
"n"

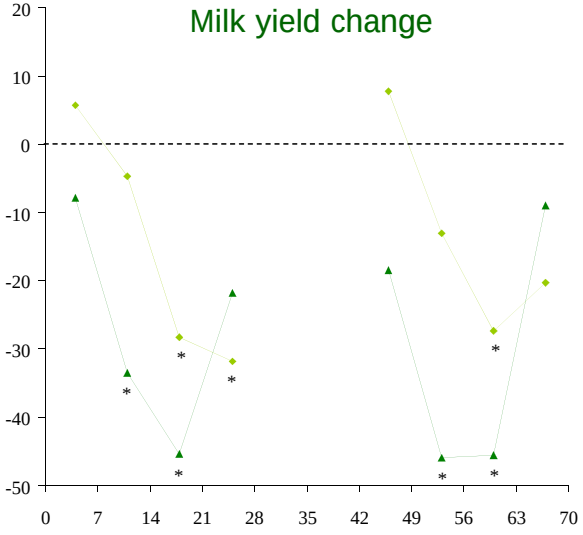
Selection for litter size

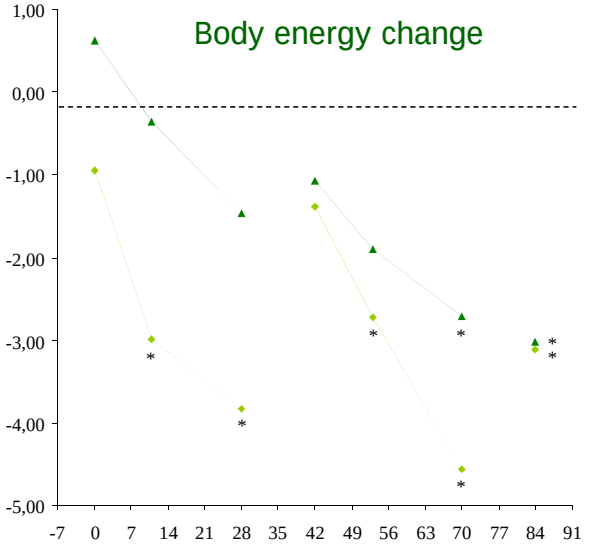
In a restricted environment: 9.1 MJ DE/kg DM

V16 **8.5[a]**

V36 **10.1[b]**







When resources are limited selection for litter size:

+ ↓ Intake
+ ↓ Milk yield

↓ Priority for current litter

+ ↑ Body energy
+ ↑ Litter size

↑ Priority for next litter

Selection for litter size seems to increase the environmental sensitivity of the animals

Perhaps no a weakness !!

Strategy to ensure its evolutionary success ??

Selection for longevity

Theilgaard *et al.*, 2007

♀ line V

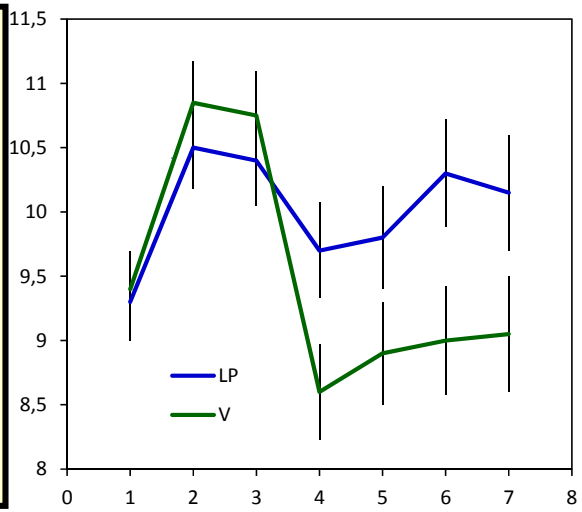
Selected for litter size at weaning during 31 generations

vs.

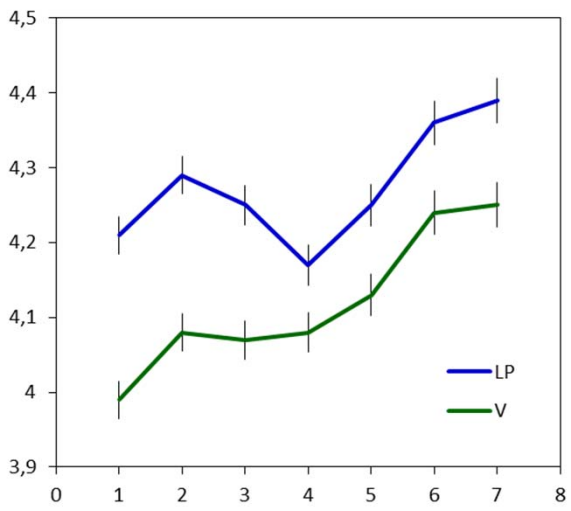
♀ line LP

Founded using animals with at least 25 parities and 8.5 kits weaned

No. born alive



Body weight (kg)



Selection for reproductive longevity:

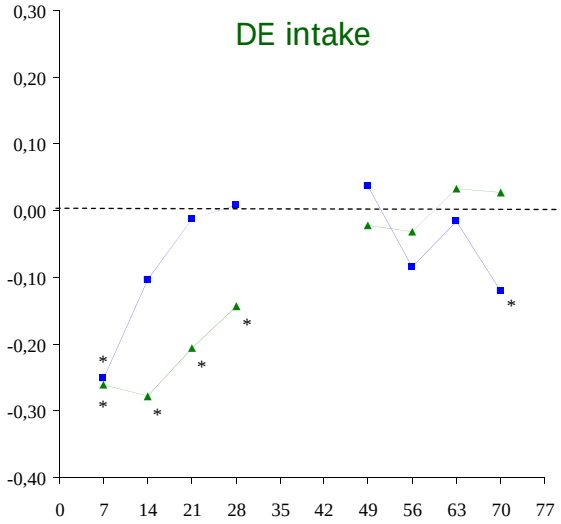
- No relevant reduction of reproduction
- Delay of senescence??
- Greater soma: higher plasticity under high productive conditions.
- Use of body reserves to maintain reproduction under challenge conditions?

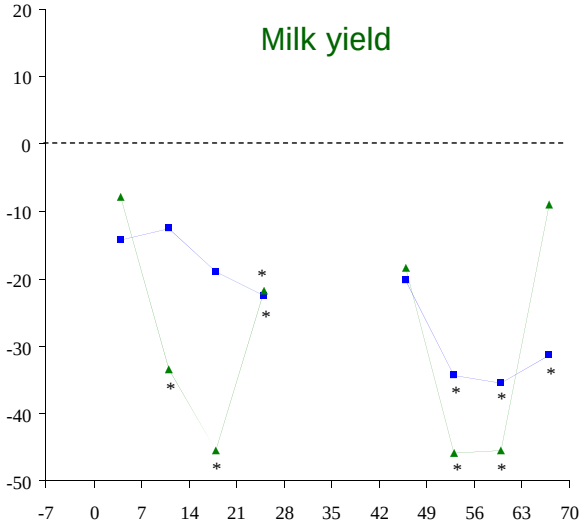
Selection for longevity

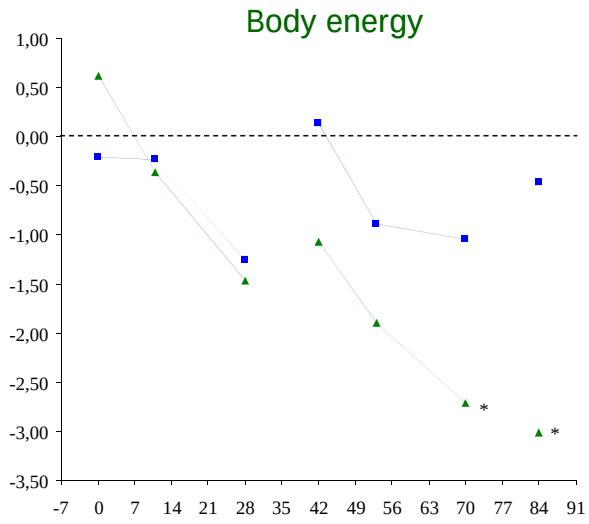
In a restricted environment: 9.1 MJ DE/kg DM

Effect of restriction in No. born alive

	2nd partum	3rd partum
LP	+0.26	–0.53
V36	–0.72	–2.55*







When the resources are limited, foundation for reproductive longevity:

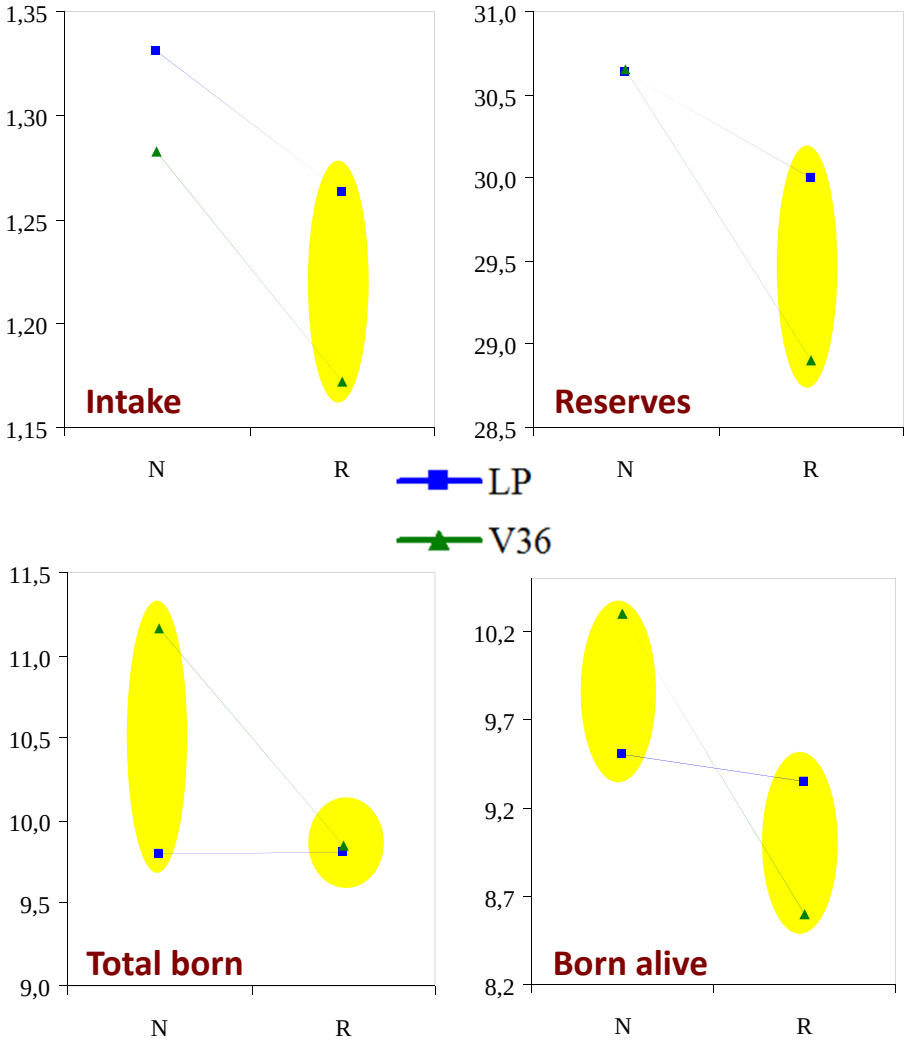
First lactation:

+ Quick adaptation to DE level
+ Lower reduction: Milk yield
  Body energy
  Born alive at 2nd partum

Second lactation:

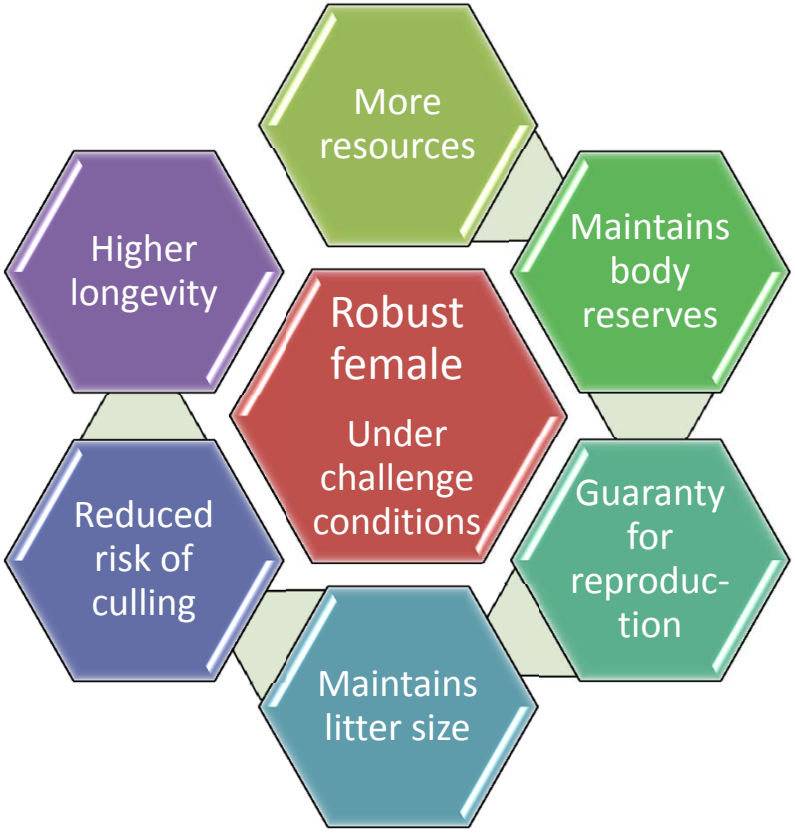
+ Both lines adapted to DE level
+ Clear symptoms of exhaustion in V36
  ↓ Body energy
  ↓ Born alive at 3rd partum

Robustness



"Robust females:
less sensible to environment"

"Stable production in long term without boast"

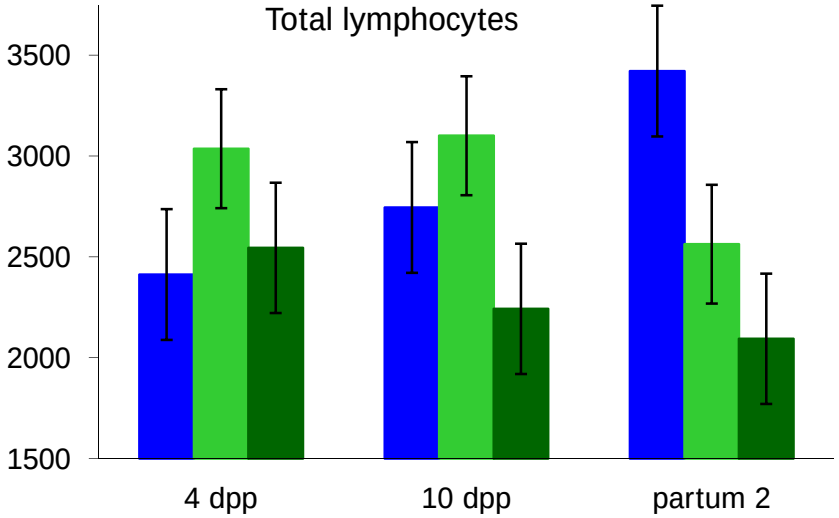


Robustness – Immune response

Normal conditions (14-20ºC) (Ferrian et al., 2012a)

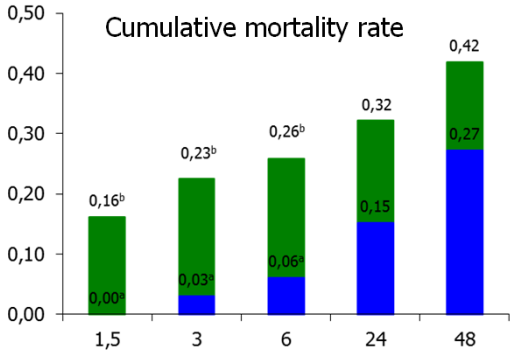
	LP	V16	V36
Total lymphocytes (10^6/L)	2816^{b}	2969^{b}	2467^{a}
B Lymphocytes (10^6/L)	131^{ab}	167^{b}	107^{ab}
$CD25^+$ (10^6/L)	52^{b}	40^{b}	31^{b}

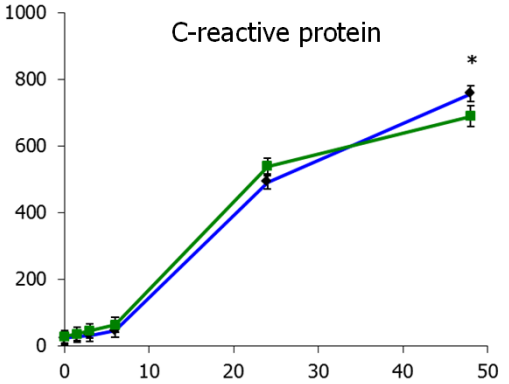
Heat stress conditions (25-36ºC)

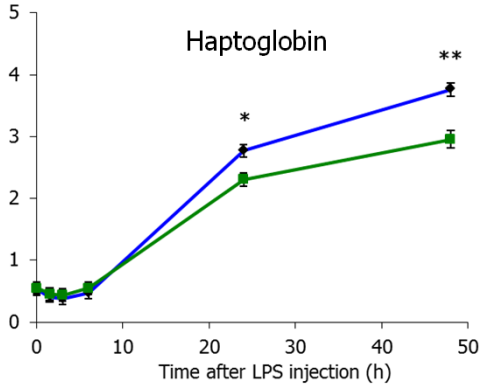


Could be improved the general health conditions of the farm using animals with a higher robutsness?

Immunological challenge with LPS (Ferrian et al., 2012b)





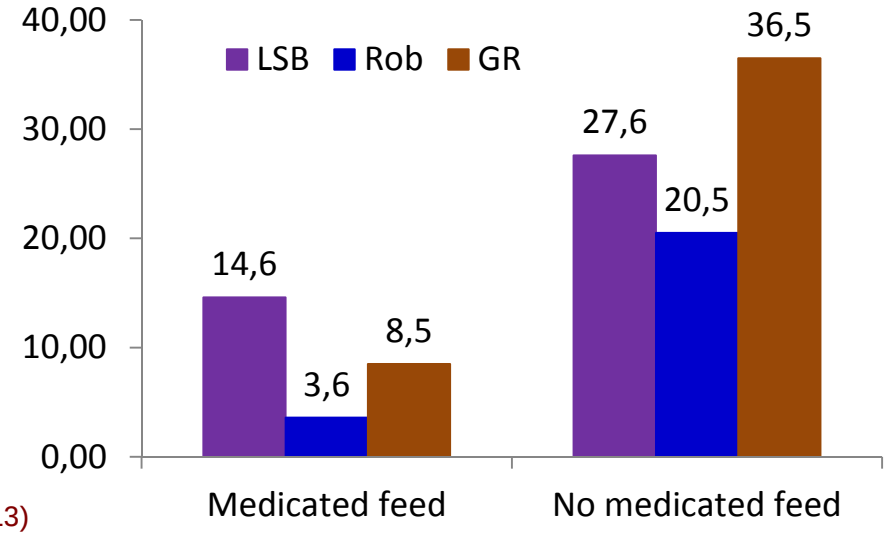


Robustness – Immune response

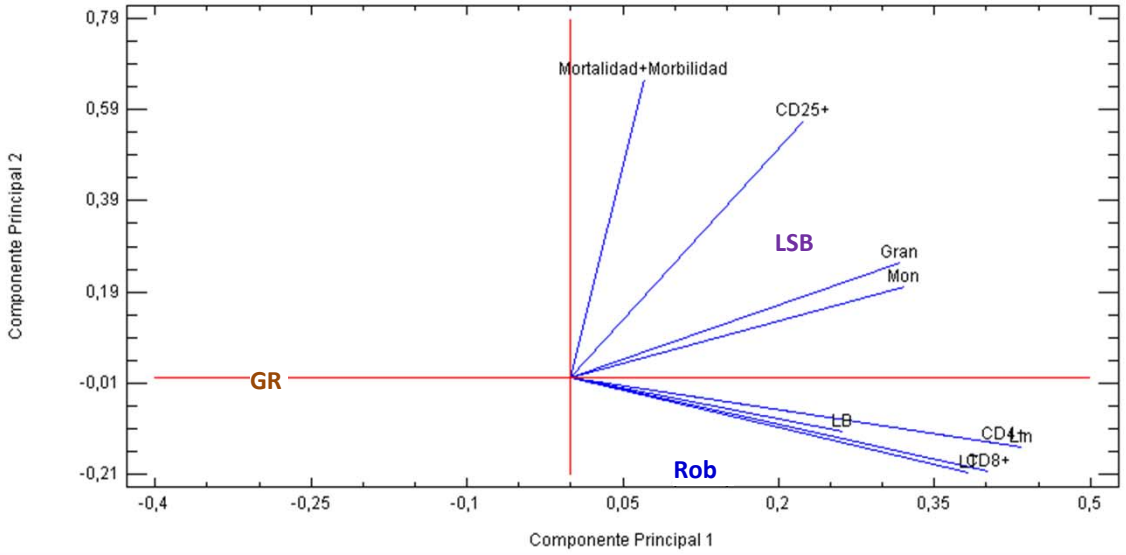
Genetic selection- Growing period (Arnau et al., 2013)

	LSB	Rob	GR
Daily weight gain (g/d)	35,4[a]	35,5[a]	45,8[b]
Mortality (%)	19,0[b]	9,5[a]	16,5[b]
Morbidity (%)	6,6[b]	3,9[b]	9,9[b]

Mortality %



Lymphocytes counts at weaning (García-Quirós et al., 2013)



Further efforts about the possible effect of genetic type on young rabbits health is needed !!

Conclusions

1. Resources allocation (partitioning of available resources into vital functions) are genetically driven, and they are mainly addressed to allow expression of the traits selected in rabbit females.
2. When environment ensure enough resources, selection can improve economic traits without penalties.
3. But when it becomes limiting, preferential allocation of resources in 'selected' traits (growth, reproduction...), can reduce the ability of animals to respond to other demands (such as coping with disease, stress...).
4. Main works show that genetic selection in rabbit by litter size at weaning has increased prolificacy but also the ability to obtain resources, without compromising the survival of rabbit females when resources are ensured.
5. However, farms are frequently subjected to punctual challenges (feed quality, heat stress, pathogens...). Under these conditions, particular nutrient partitioning of females characterised by a higher robustness could be recommended to maintain an adequate productive level in long-term.



Grazie mille

jupascu@dca.upv.es

Suitable feeding and breeding programmes