iSAGE

Innovation for Sustainable Sheep and Goat Production in Europe

CIHEAM

FAO-CIHEAM Networks on sheep and goats and Mediterranean pastures

iSAGE Workshop

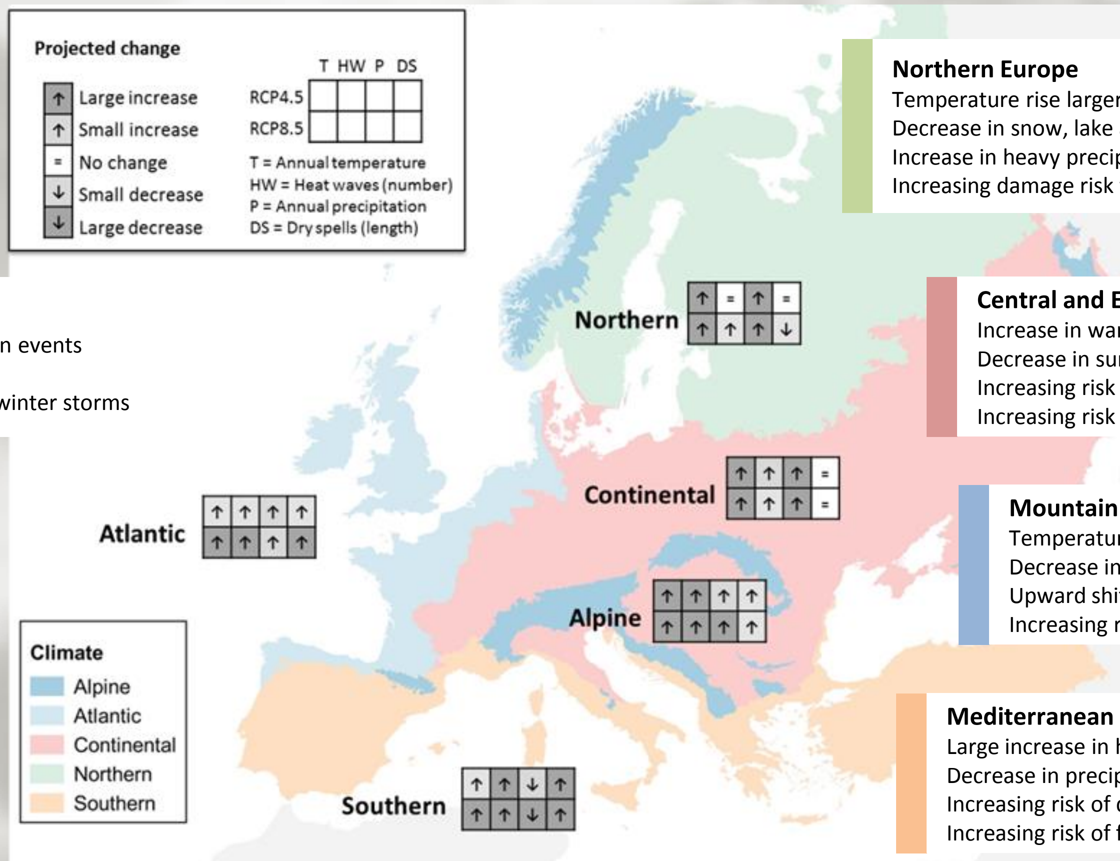
23–25 October 2019, Meknès (Morocco)

Challenges of climate change in the Mediterranean livestock systems

bc3 BASQUE CENTRE FOR CLIMATE CHANGE Klima Aldaketa Ikergai

Regional implications for small ruminant production systems in Europe:

- Climate change impacts will vary among the different European sub-regions



Northern Europe
Temperature rise larger than global average
Decrease in snow, lake and river ice cover
Increase in heavy precipitation events
Increasing damage risk from winter storms

North-western Europe
Increase in heavy precipitation events
Increasing risk of river floods
Increasing damage risk from winter storms

Central and Eastern Europe
Increase in warm temperature extremes
Decrease in summer precipitation
Increasing risk of forest fires
Increasing risk of river floods

Mountain regions
Temperature rise larger than global average
Decrease in mountain permafrost areas
Upward shift of plant species
Increasing risk of soil erosion

Mediterranean region
Large increase in heat extremes
Decrease in precipitation
Increasing risk of droughts
Increasing risk of forest fires

Figure - General trends of several climate variables for European sub-regions. Indices represent changes for 2071-2100 with respect to 1971-2000 based on RCP4.5 and RCP8.5 scenarios (Pardo et al 2017 based on Jacob et al, 2014).

Regional implications for small ruminant production systems in Europe:

- Climate influences distribution of vegetation and small ruminant systems across Europe

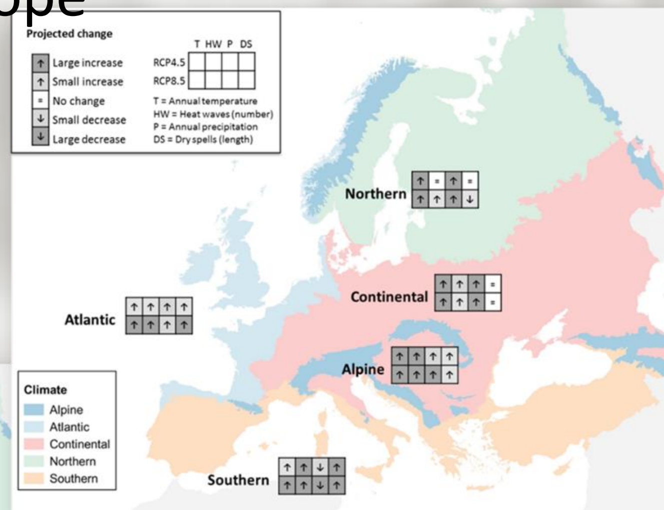


Fig.1- Climate change projections

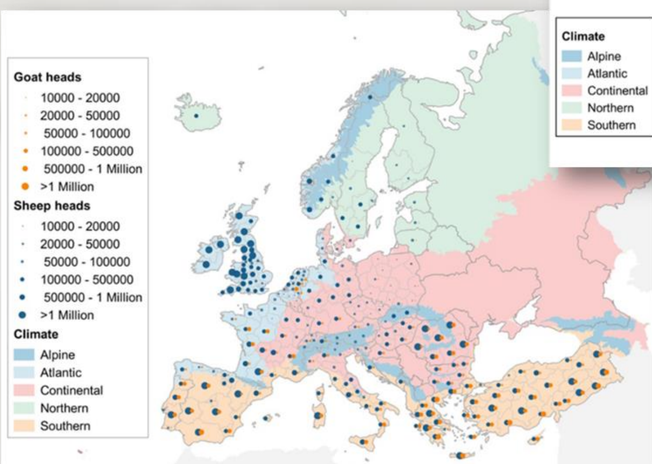


Fig.2 - Distribution of small ruminant livestock in Europe

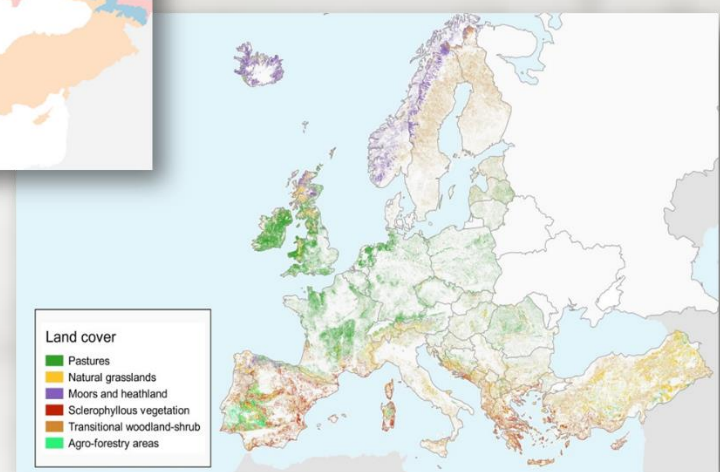


Fig.3 - Distribution of grasslands and scrublands in Europe

Regional impacts of climate change:
E) Southern (Mediterranean) region

- Reduction in forage yields due to less rainfall and risk of drought projection
- Grazing season is expected to be shortened. Grazing activity will suffer from irregular patterns due to extreme events.
- Encroachment (increase of shrubs)
- Soil erosion and degradation
- Heat stress in animals: more frequency and length of heat waves

Southern (Mediterranean) region

General adaptation strategies for forage production to face CC

- Increase pasture diversity:
  - to enhance resilience under variable climatic conditions
  - to adapt to potential shortages of protein sources (mixed legume-grass)
- Reduce tillage:
  - soil moisture conservation
  - long-term productivity (increase soil organic matter)
- Improved plant breeding (long-term):
  - developing varieties that can survive long drought periods and recover rapidly following autumn rains (e.g. tall fescue, cocksfoot and Lucerne varieties)

E) Southern (Mediterranean) region

Adaptation measures: Flexible grazing and alternative feed resources:

- Crop residues: Post-harvest cereals, olive leaves
- Underutilized feedstuffs from agro-industry by-products
  - Olive cake
  - Citrus pulp
  - Tomato by-products
  - Other vegetables and fruits (e.g. cucumbers, pomegranate)
- Fodder trees/shrubs (cactus cladodes, saltbush)

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E) Southern (Mediterranean) region

Adaptation measures: Flexible grazing and alternative feeds:

- Integrated approaches:
  - soil and water protection (cover crops)

E) Southern (Mediterranean) region

Adaptation measures: Flexible grazing and alternative feeds:

- Integrated approaches:
  - soil and water protection (cover crops)
  - different feeds aligned to different seasonal constraints (agro-forestry)

- In winter grass growth preferably beneath tree canopy
- In early summer grasses dry later beneath canopy because the shelter/buffering effect of trees on temperature

Dehesa system in Sierra de Gata, Extremadura (Spain)
Source: http://reservabiologicacampanarios.es/

Pasture under trees in winter

Pasture under trees in early June

Pictures taken in Iberian dehesas (CW Spain) by D. Howlett and A. Carrara, respectively.

E) Southern (Mediterranean) region

Adaptation measures: Flexible grazing and alternative feeds:

- Integrated approaches:
  - soil and water protection (cover crops)
  - different feeds aligned to different seasonal constraints (agro-forestry)
  - fire-risk protection (grazing management)

E) Southern (Mediterranean) region

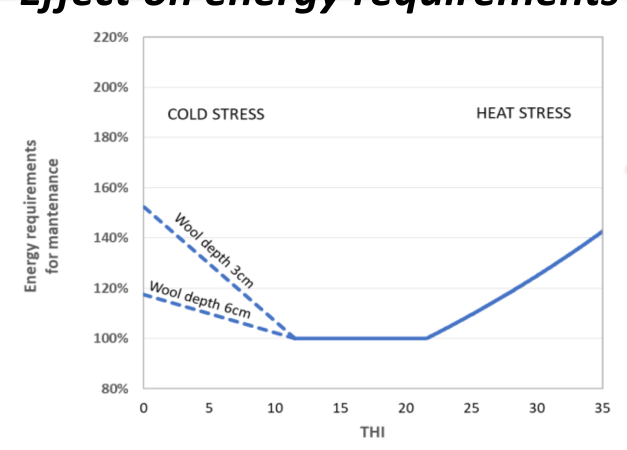
Adaptation measures to cope with heat stress:

- Prevention/mitigation of heat stress conditions
  - -Indoors: stock density, barn orientation/dimensions, ventilation, spraying
  - -Outdoors: provide protection with trees or artificial shelters
- Feeding/Nutritional management:
  - -shifting meals to late afternoon or evening, increasing number of meals
  - -low fibre diets (decrease forage:concentrate), increase energy, supplements (fat-rich feeds, whole flaxseed)
- Animal breeding
- Reproduction techniques

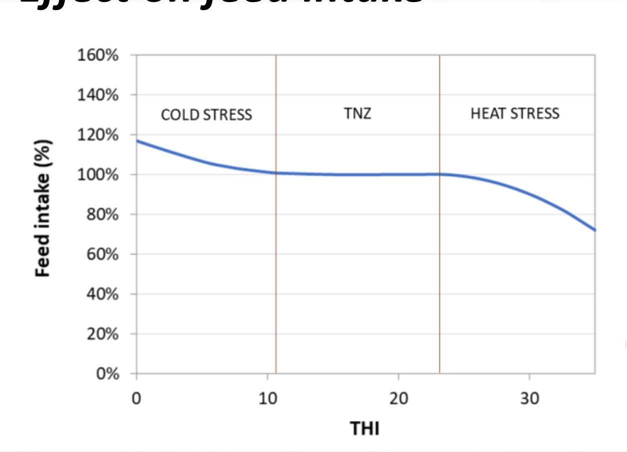
Development of models on animal performance:

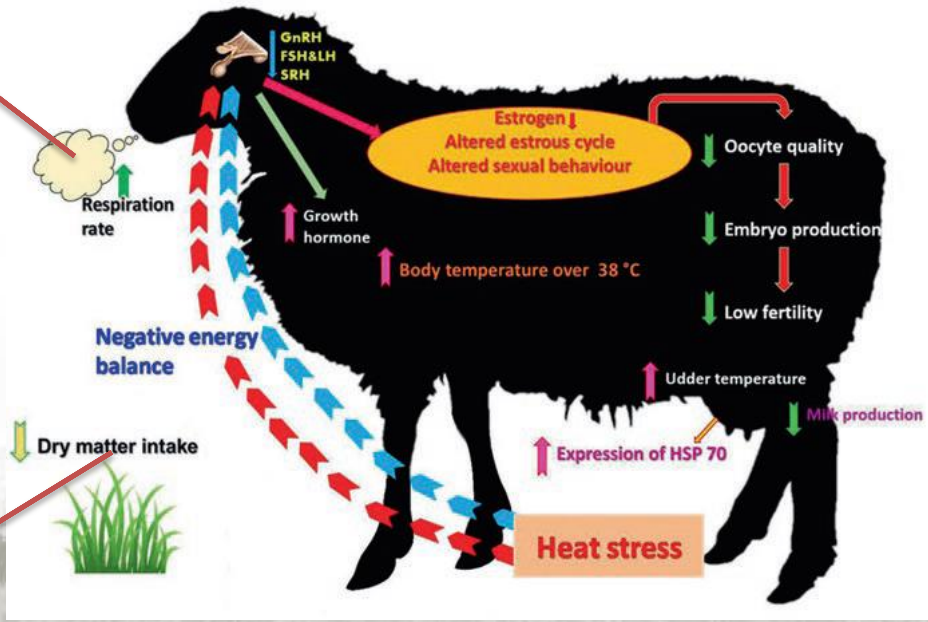
Semi-mechanistic model:

Effect on energy requirements



Effect on feed intake





Sejian et al., 2017

Development of models on animal performance:

Semi-mechanistic model:

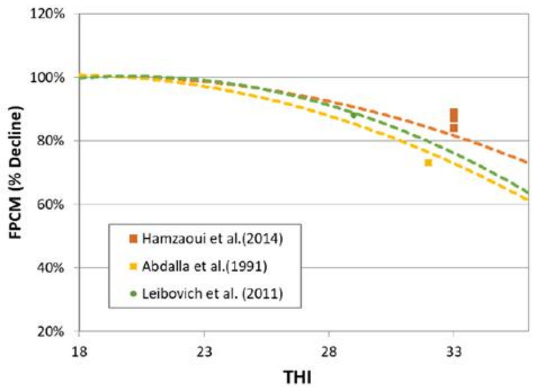


Figure 13 – Estimated (dotted lines) vs measured reduction (%) of FPCM of dairy small ruminants under heat stress (Datasets from Abdalla et al 1993; Hamzaoui et al 2014; Leibovich et al 2011)

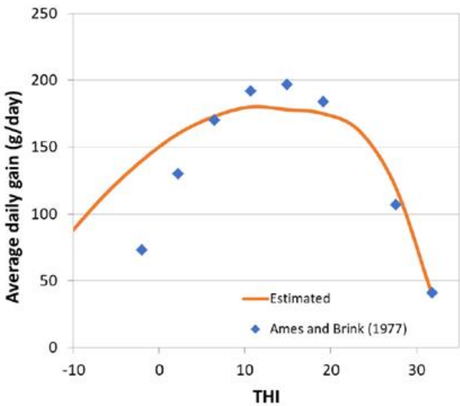


Figure 15 – Estimated (line) vs measured average daily gain of growing lambs under heat stress (Datasets from Ames and Brink, 1977)

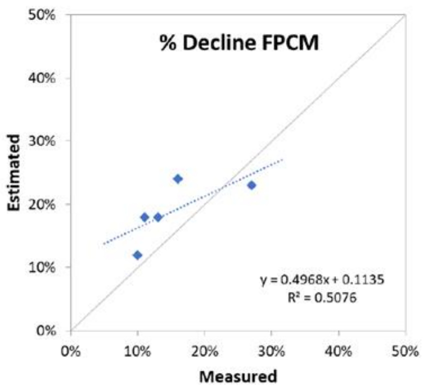


Figure 14 - Estimated vs measured reduction (%) of FPCM of dairy small ruminants under heat stress (Datasets from Abdalla et al 1993; Hamzaoui et al 2014; Leibovich et al 2011)

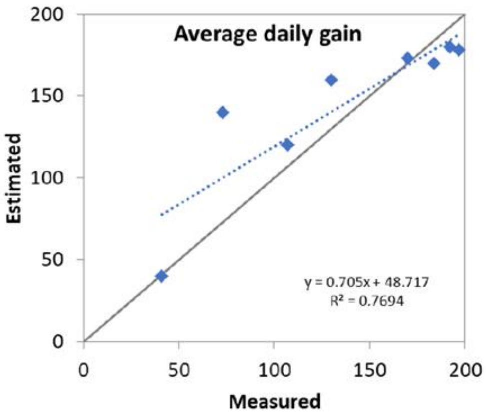


Figure 16 – Estimated vs measured average daily gain of growing lambs under heat stress (Datasets from Ames and Brink, 1977)

Testing the modelling approach (lamb growth)

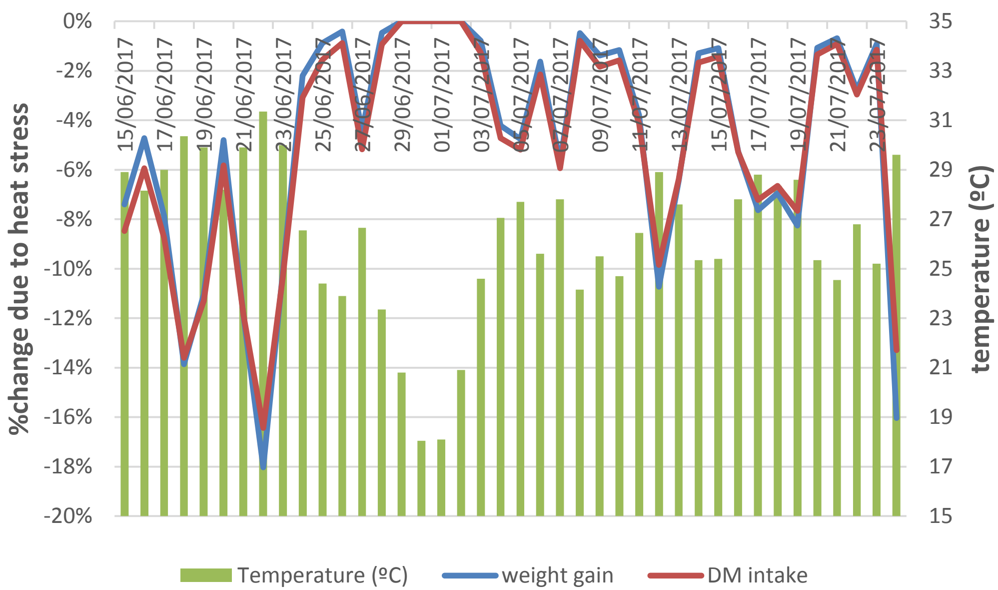
- Breed: rasa Aragonesa
- Location: Zaragoza (Spain) (June-July 2017)
- Effect of heat on Lamb growth (born in May)
- Period of study: from weaning (13.9 kg LW) to slaughter (22 kg LW)
- Number of ewes: 550, 650 lambs sold/yr (40% born in May)

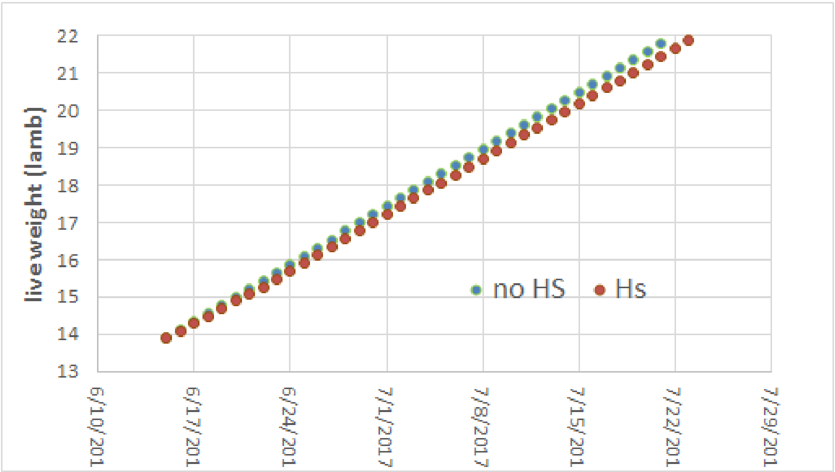
Diet composition (wean to slaughter)

FEED	%	GE MJ/kg DM	DE MJ/kg DM	ME MJ/kg DM
Barley	33.6%	18.4	14.8	12.4
Maize	27.3%	18.7	16.1	13.6
Soybean Meal	23.6%	19.7	18.2	13.6
Wheat	6.4%	18.2	15.6	13.1
straw	9.0%	18.2	8	6.5

Effect of heat on Lamb growth & DM Intake

Lamb growth reduction and DM intake (%)





2 extra days with heat stress

450 g DM extra/lamb

228 kg extra concentrates

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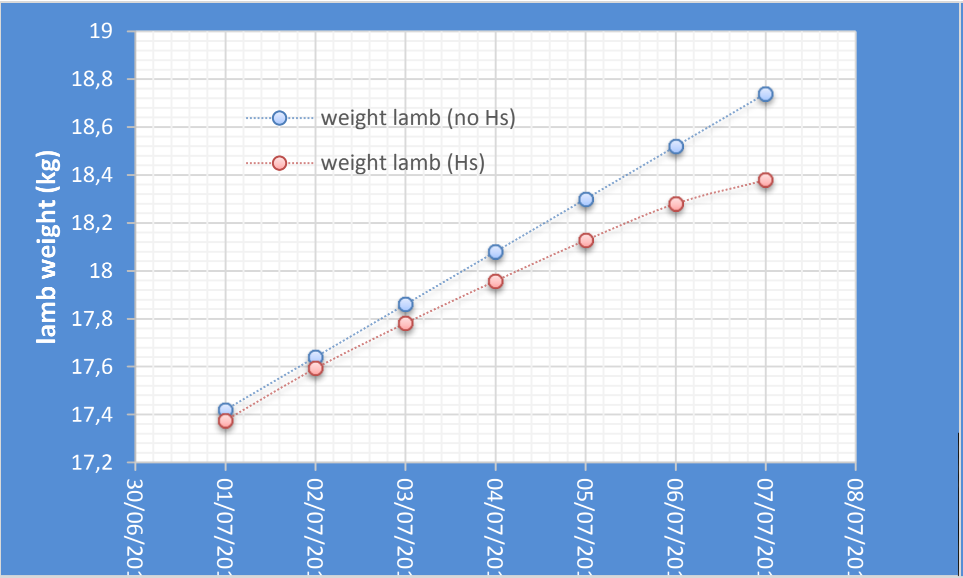
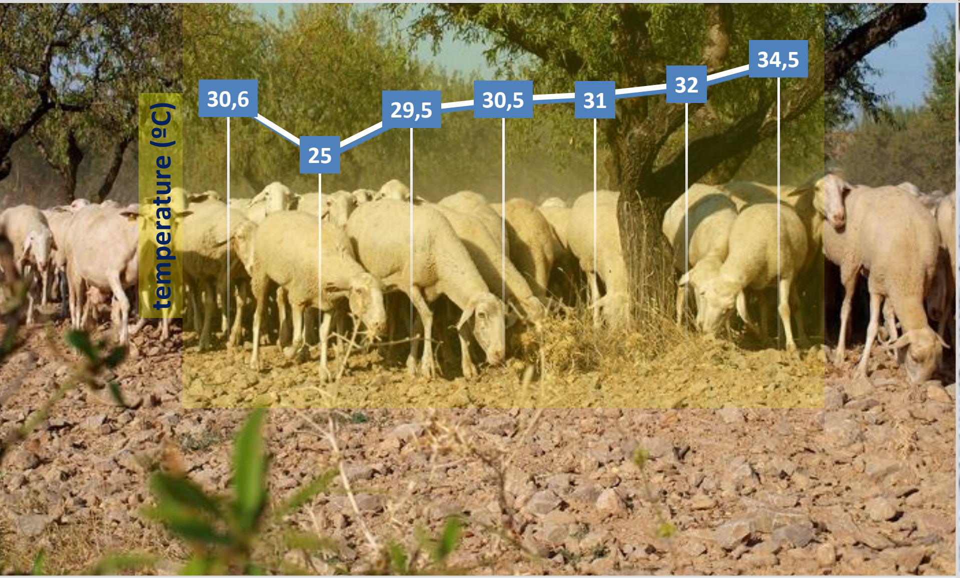
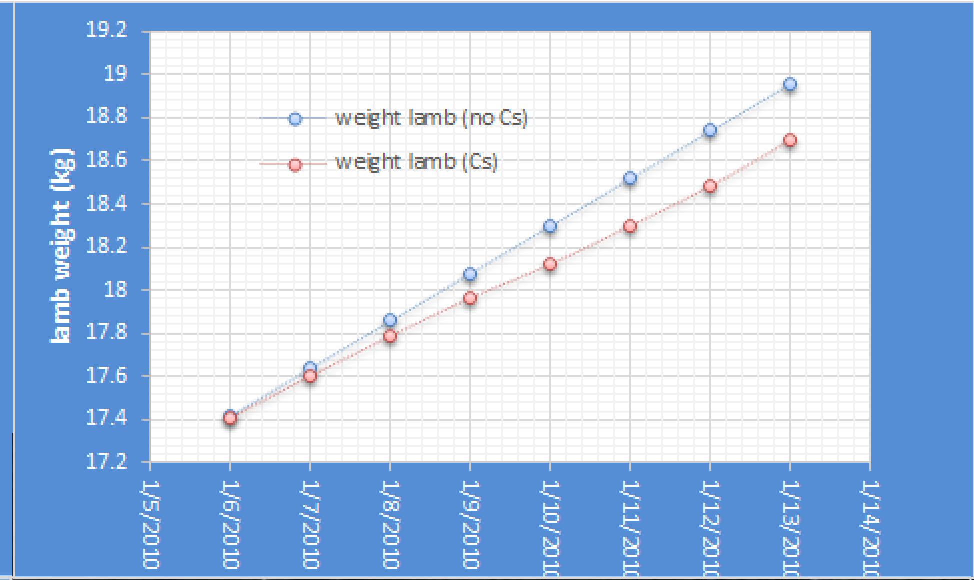
Extremes (heat and cold wave)

Born in May (Heat stress)





Born in January (Cold stress)



Testing the modelling approach (impact on milk& adaptation)

- Breed: Manchega (Spain)
- Effect of heat on milk productivity on Summer period
- Housed

Diet composition

FEED		GE	DE	ME
	%	MJ/kg DM	MJ/kg DM	MJ/kg DM
Alfalfa hay	90%	18.2	10.6	8.4
Corn	10%	18.7	16.1	13.6

4 scenarios

- No HS
- HS (non-adapted)
- HS (adapted-diet)
- HS (Adapted-spraying)

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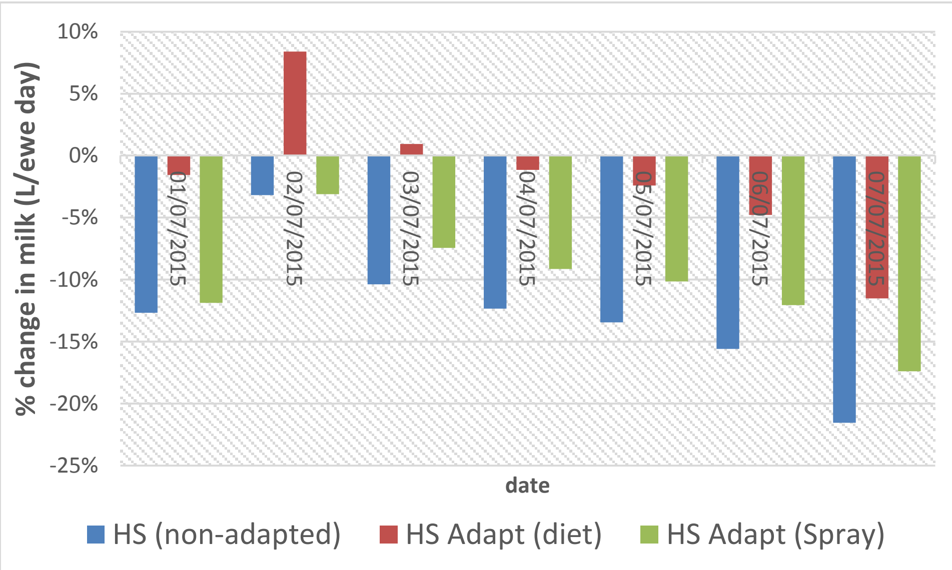
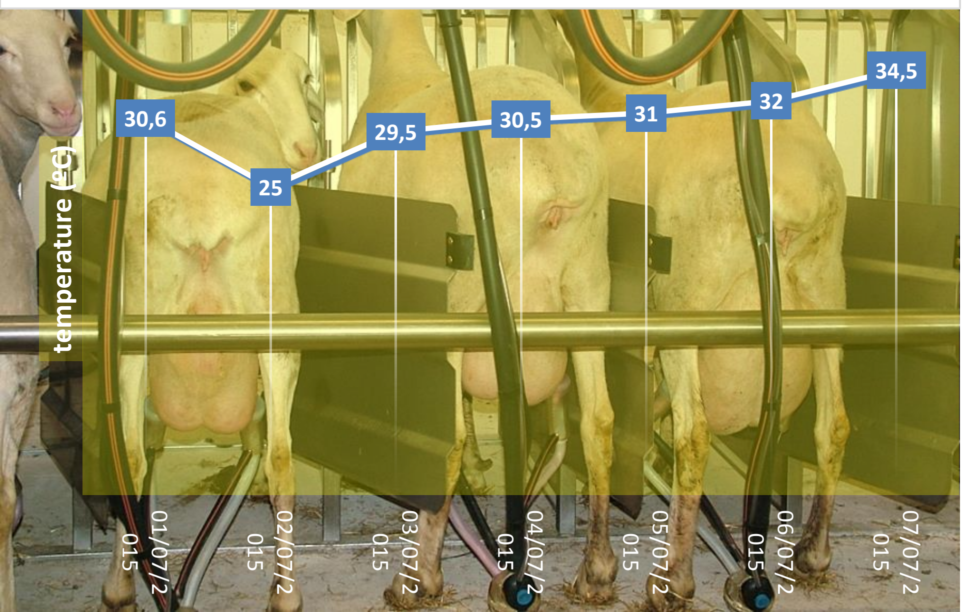
Effect of heat on milk production & DM intake





HS (non-adapted)

Aprox. 13% reduction in milk,
0.12 kgDM extra/L milk

HS (adapt-diet)

More dense diet: more soybean meal
Aprox. 2% reduction in milk,

HS (adapt-spraying)

Small positive effect, aprox. 10% reduction in milk

Thank you!

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agustin.delprado@bc3research.org

guillermo.pardo@bc3research.org