iSAGE Innovation for Sustainable Sheep and Goat Production in Europe

SRUC

Breeding strategies to enhance animal resilience

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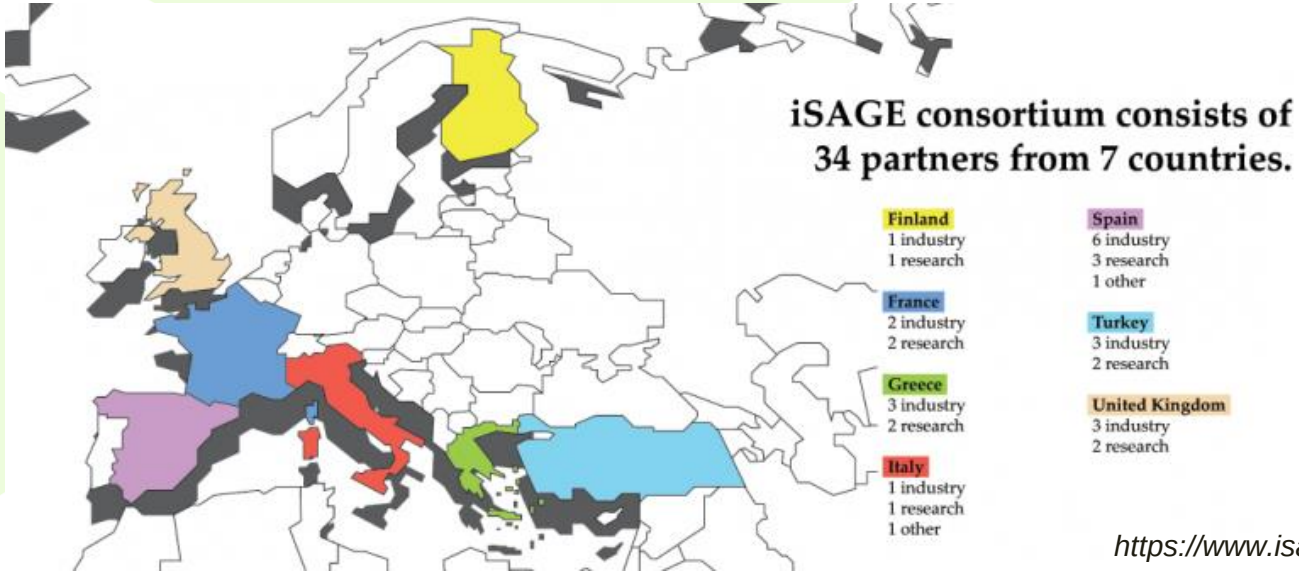
Leading the way in Agriculture and Rural Research, Education and Consulting

The iSAGE project

- **Challenges**
  - Sustainability
  - Socio-demographics
  - Climate

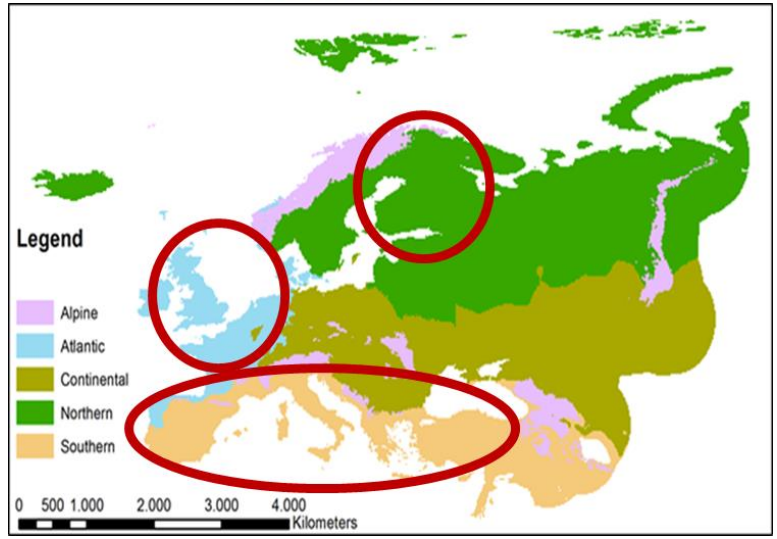
- **Solutions**
  - Farm
  - System
  - Animal



https://www.isage.eu/

The challenge

- Climate changes impacting on
  - Pastures
  - Animal production
- Increased weather volatility impacting on
  - Animal performance
- Novel animal phenotypes
  - Stability in performance regardless of weather
  - Resilience to weather change



The research

- **Work with Scottish Blackface meat sheep and Yorkshire dairy goats**

www.scottish-blackface.co.uk/

- **Parallel work by Mediterranean partners on dairy sheep**

www.sthelensfarm.co.uk/

The research

- **Joint analysis of performance records**
  - **live body weight records (4 measurements during growth)**
  - **daily milk yield records throughout lactation**

- **with weather variables**
  - **temperature, humidity, THI**
  - **before or at the time of performance record**

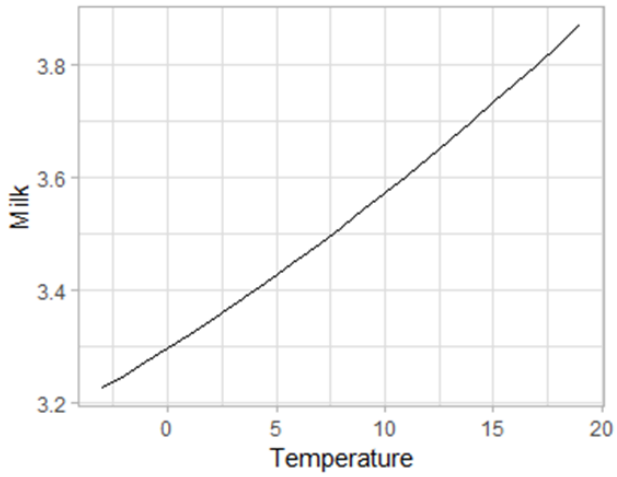
www.scottish-blackface.co.uk/

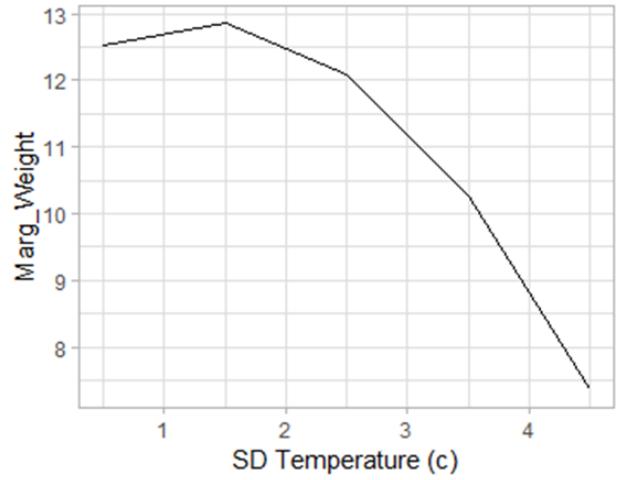
www.sthelensfarm.co.uk/

The method

- Fitting reaction norm into random regression models
- Capture changes of the phenotype (performance) across an “environmental trajectory” (e.g. temperature values)

- Population level
- Individual animal

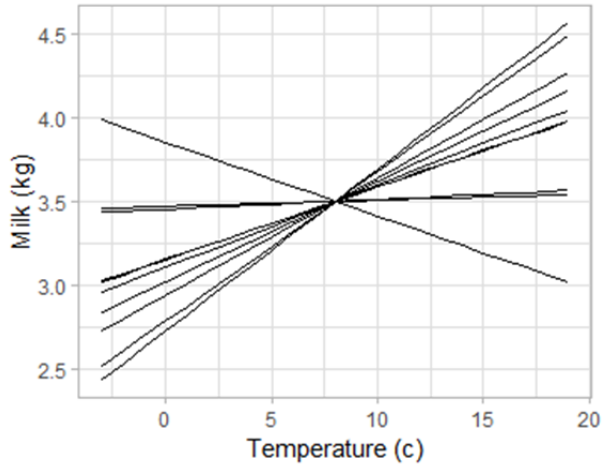


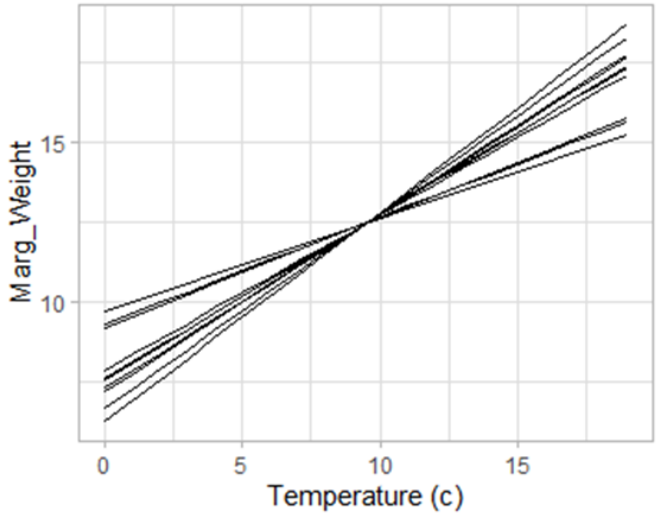


Sánchez-Molano et al. 2019. BMC Genetics

The outcomes - phenotypes

- **Variation observed among individual animals**
  - **Different animals react differently to weather challenge**
- **“Flat” lines ➔ unaffected performance (desirable)**
- **Otherwise ➔ performance affected by weather volatility**

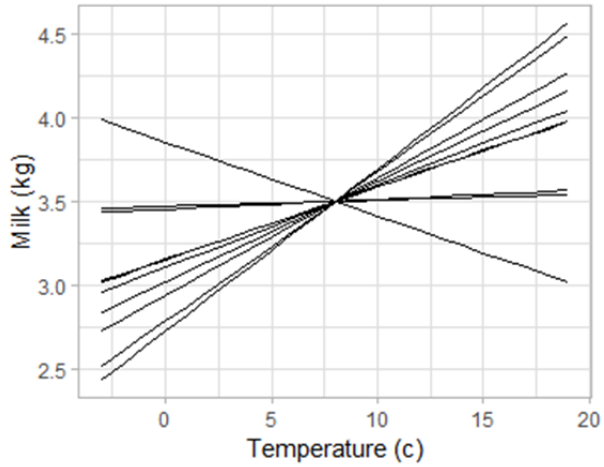




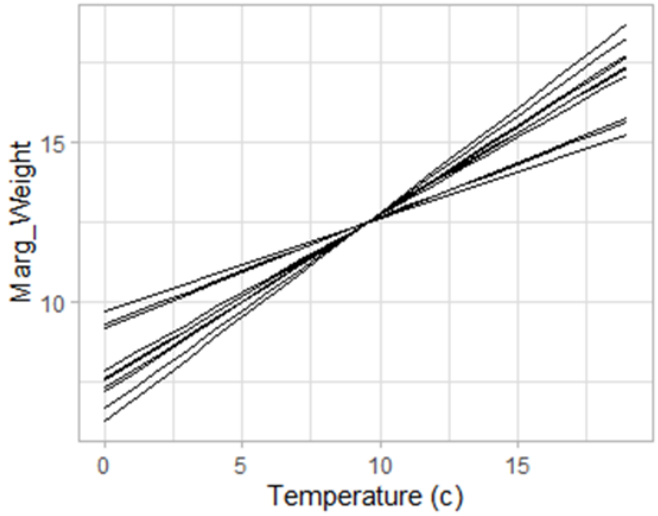
Sánchez-Molano et al. 2019. BMC Genetics

The outcomes - phenotypes

- **Novel phenotypes reflecting how animal performance is affected by weather volatility**



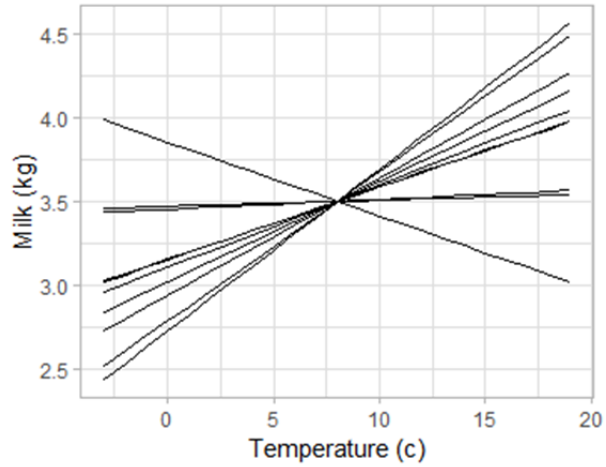
- **Useful to identify the "unaffected" animals (considered well-adapted, resilient) vis-à-vis the most affected ones**

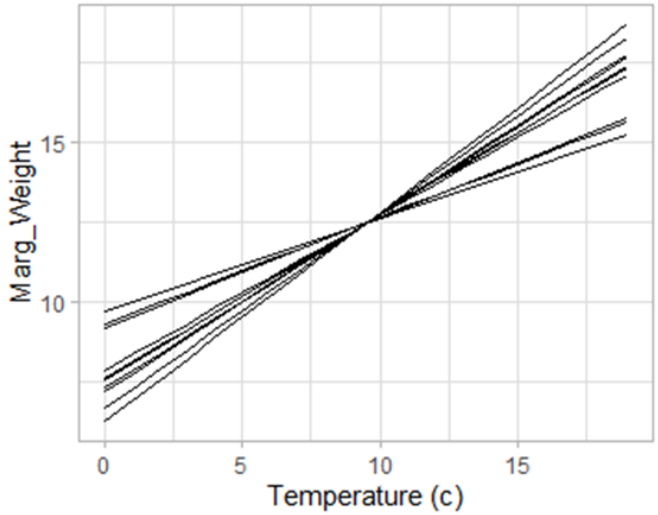


Sánchez-Molano et al. 2019. BMC Genetics

The outcomes - genetics

- Part of the variation is genetic
- Heritability sheep
  - 0.14 – 0.16 lamb trait
  - 0.05 – 0.10 ewe trait
- Heritability goats
  - 0.10 – 0.12
- May selectively breed to enhance resilience and adaptation





Sánchez-Molano et al. 2019. BMC Genetics

The outcomes - genetics

- Significant correlation with
  - Weaning weight (ca. 0.70) - antagonistic
  - Muscle depth (ca. 0.49) - antagonistic
  - Fat depth (ca. 0.43) - ?
  - Ewe litter size (ca. -0.50) - favourable ?
  - Milk yield (ca. 0.42) - antagonistic
- No correlation with
  - Carcass weight
  - Longevity (ewes, goats)
  - Mastitis (goats)
  - Fertility (goats)

- Need to enhance both level and stability of performance

The outcomes - breeding

- Simulate and assess breeding programmes
- 20 generations of selection
- 20 replicates

Starting values - Sheep

- **WWT: 21 kg**
- **FWT: 41 kg**
- **ADG: 158 g**

- **CWT: 19 kg**
- **MD: 20 mm**
- **FD: 1.5 mm**

- **LS: 1.3**
- **LONG: 2.65 lambings**

- **Res (lamb): 0.5 – 0.7**
- **Res (ewe): 0.5 – 0.7**

Starting values - Goats

- **DMY: 3.6 kg**
- **LMY: 3,464 kg**

- **LONG: 962 d**
- **Kage: 14.8 mo**
- **Mast: 14%**

- **Res: 0.03 – 0.04**

The outcomes - breeding

Lambs

- Weaning weight - increase
- Carcass weight - increase
- Muscle depth - increase
- Fat depth - stabilise

Ewes

- Weaning weight - increase
- Litter size - increase to 2
- Longevity - increase

Dairy goats

- Milk yield - increase
- Longevity - increase
- Mastitis incidence - avoid increase
- Age at first kidding - decrease to 12 mo

The outcomes - breeding

Lambs

- Weaning weight - increase
- Carcass weight - increase
- Muscle depth - increase
- Fat depth - stabilise
- Resilience - zero

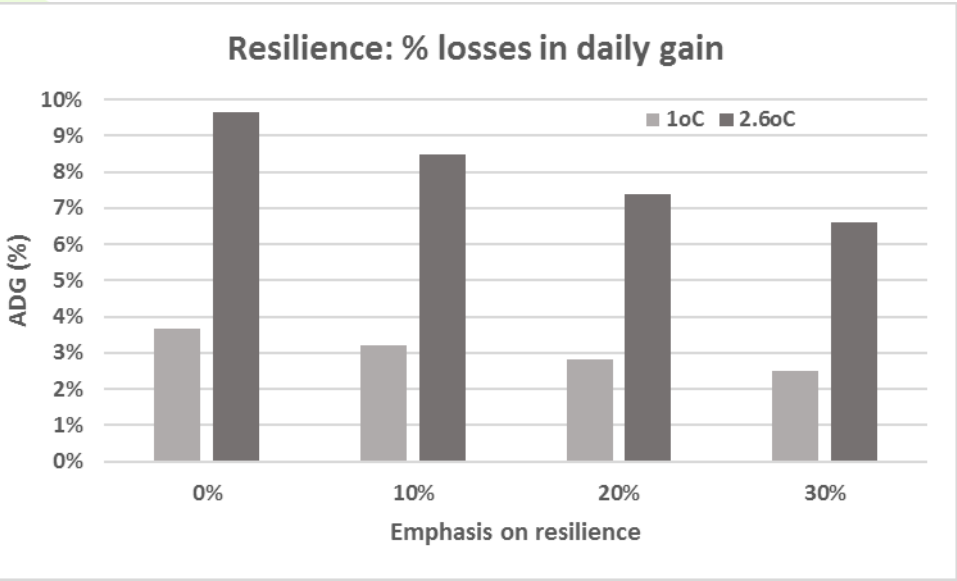
Ewes

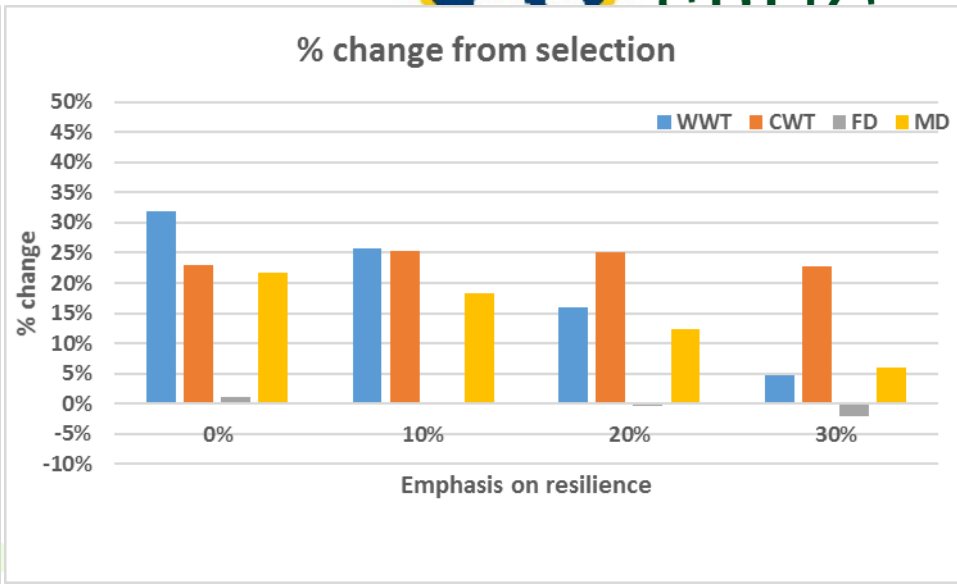
- Weaning weight - increase
- Litter size - increase to 2
- Longevity - increase
- Resilience - zero

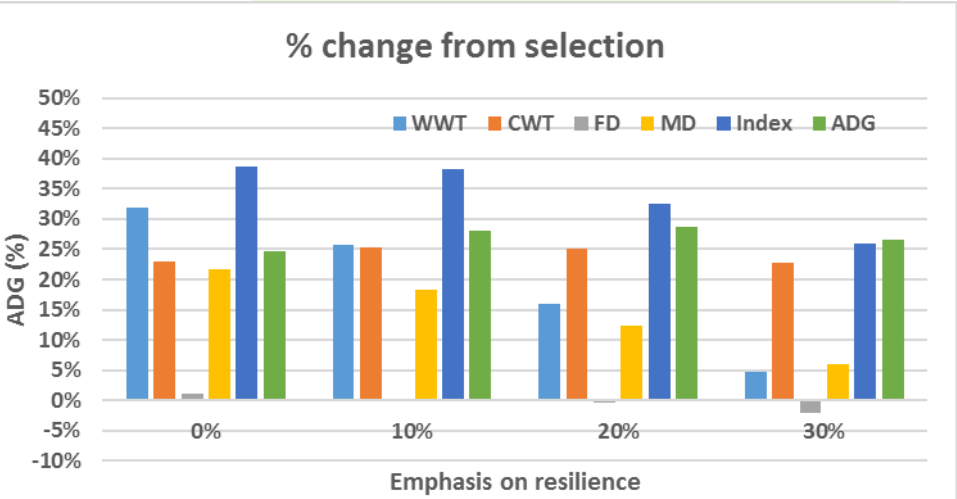
Dairy goats

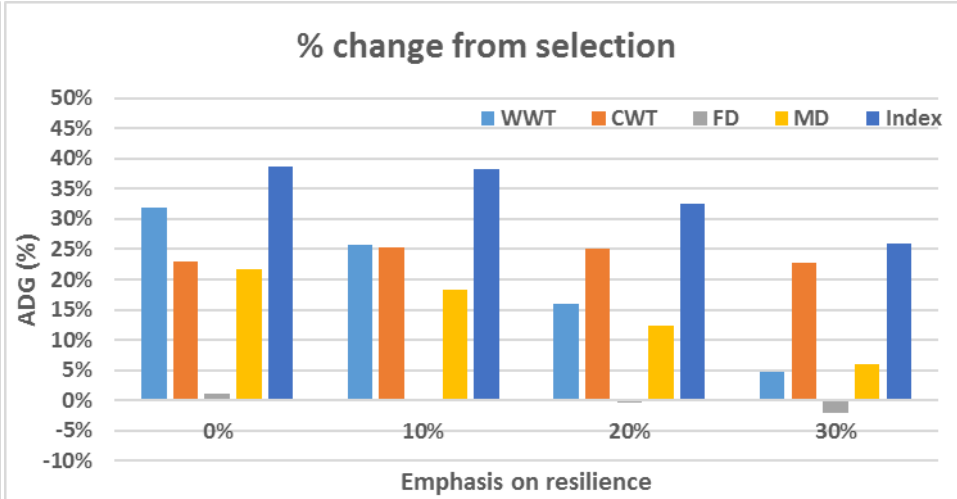
- Milk yield - increase
- Longevity - increase
- Mastitis incidence - avoid increase
- Age at first kidding - decrease to 12 mo
- Resilience - zero

The outcomes - lambs



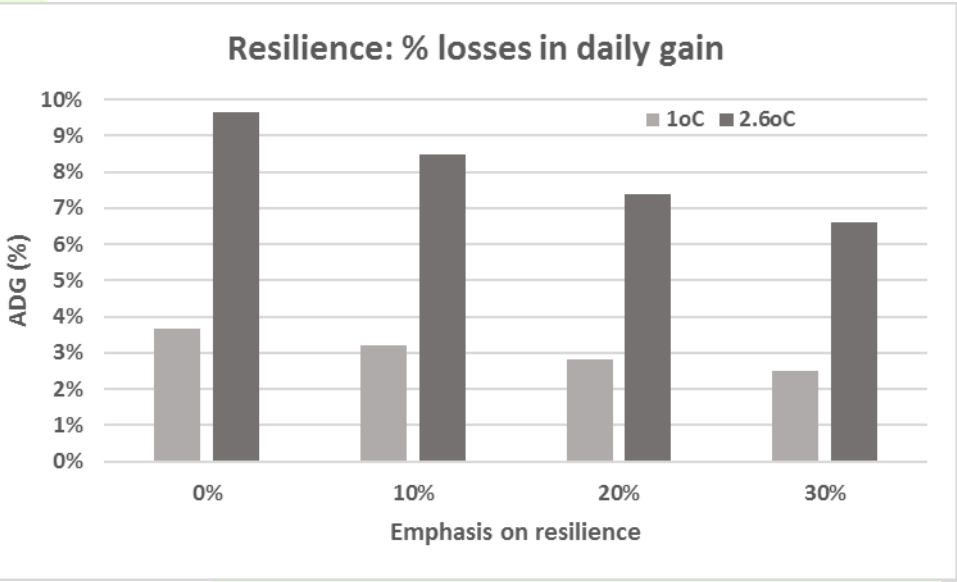


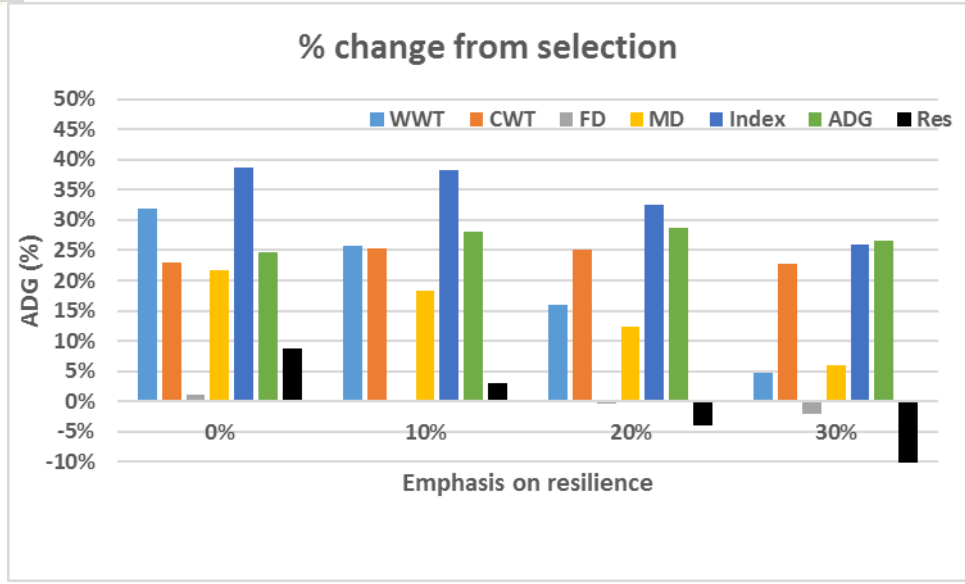




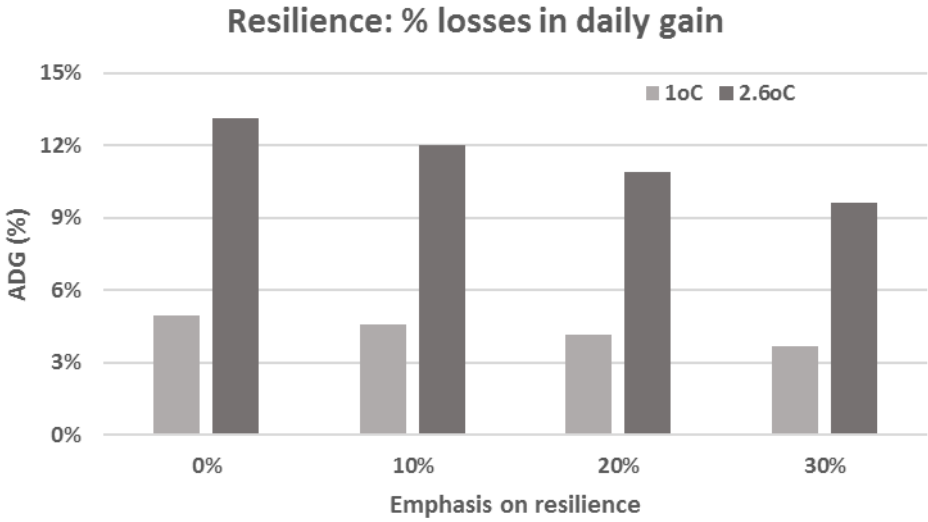
Index = 85-90% carcass, 10-15% body weight

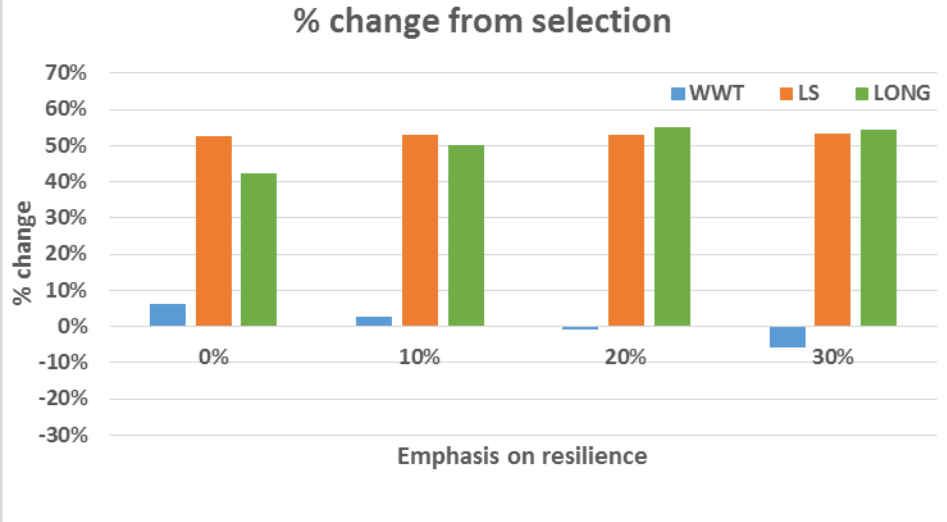
The outcomes - lambs

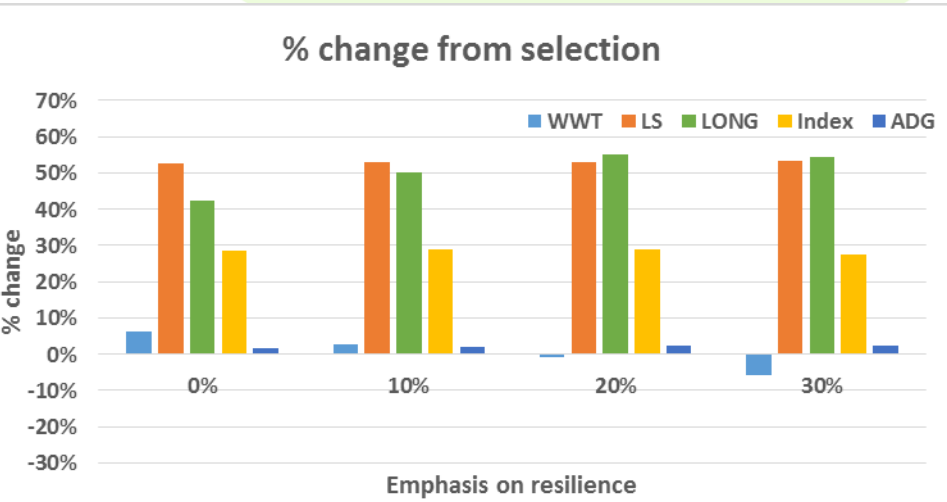


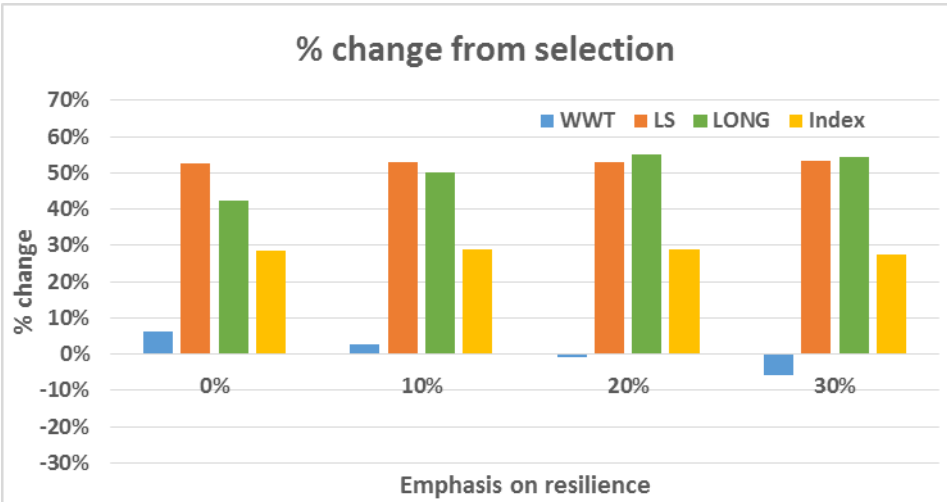


The outcomes - ewes



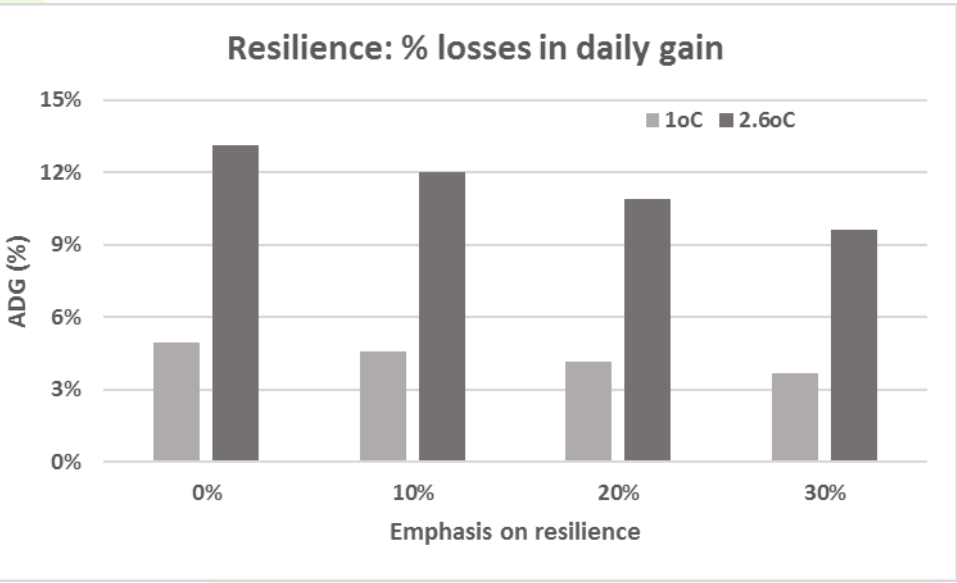


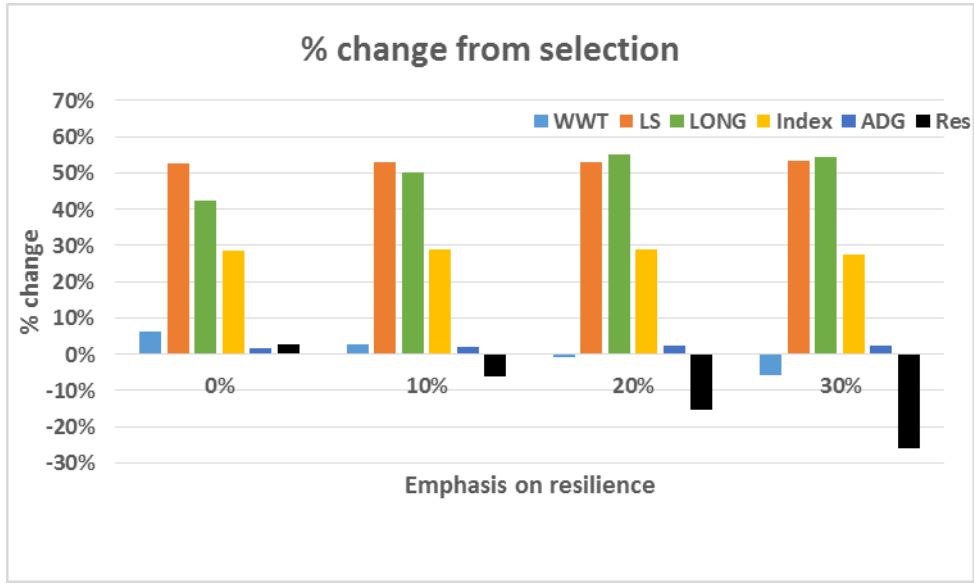




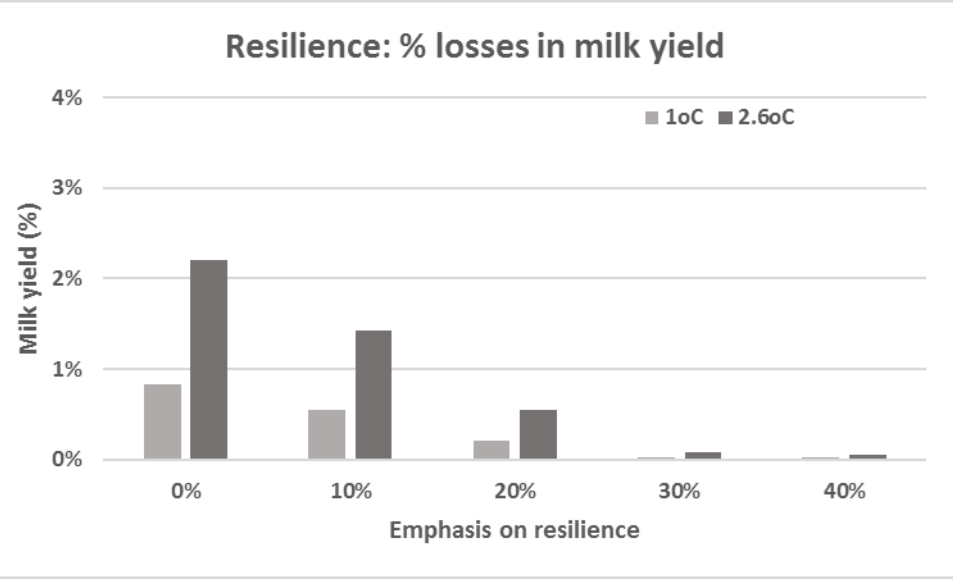
Index = 80%(LS+LONG), 20% body weight

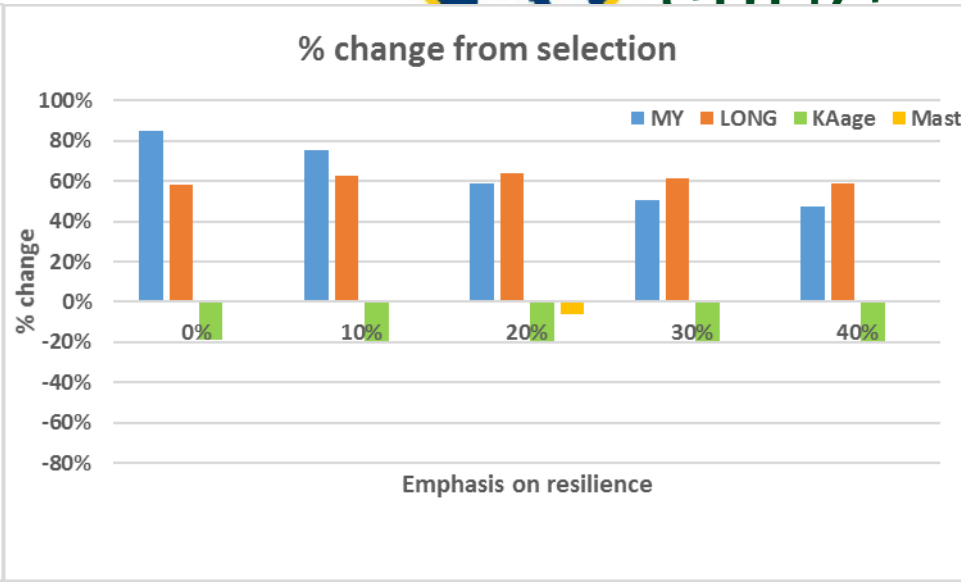
The outcomes - ewes

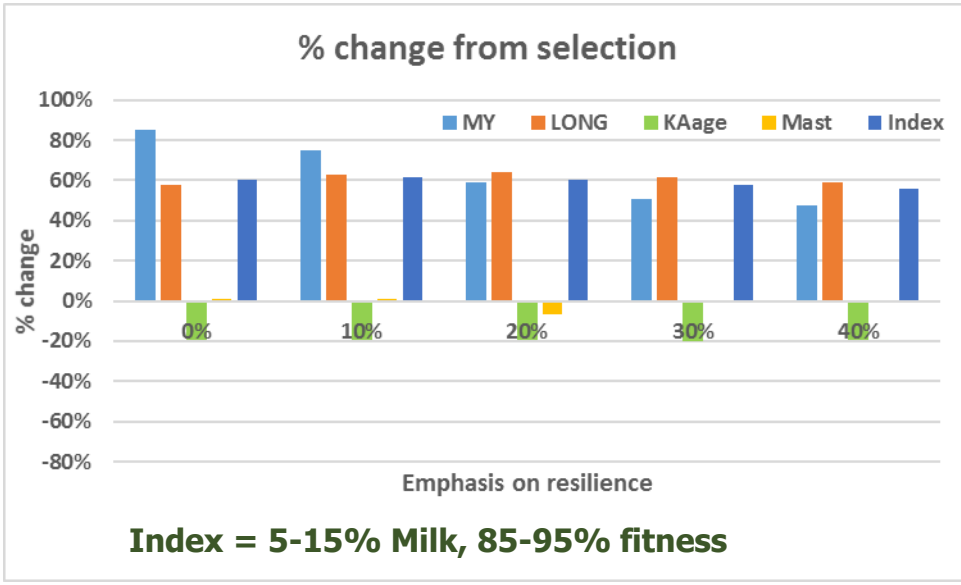




The outcomes – goats

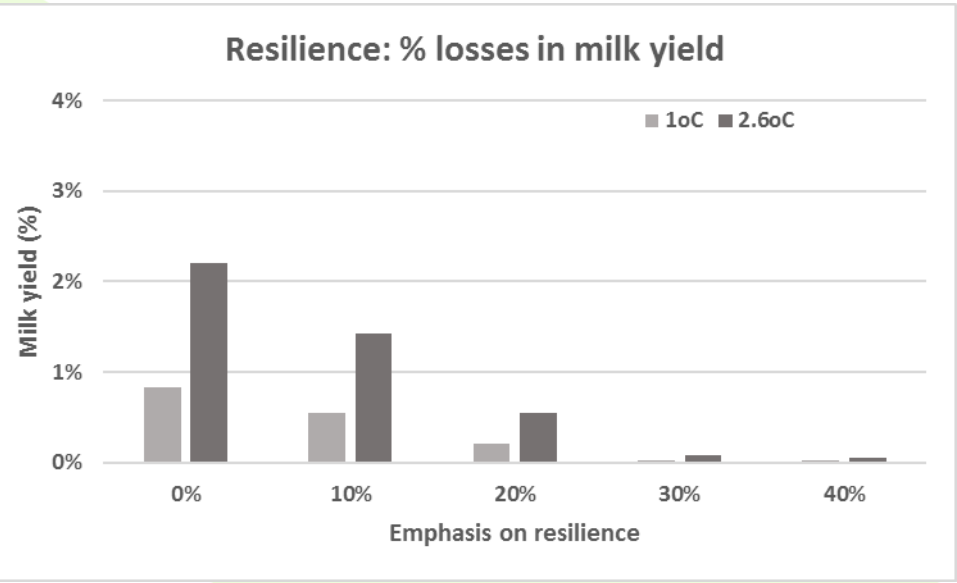


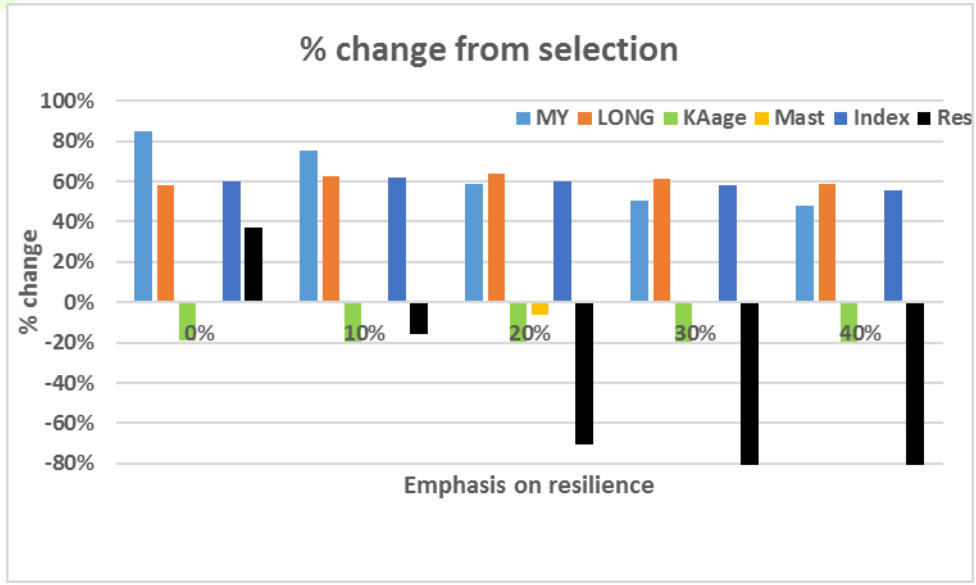




Index = 5-15% Milk, 85-95% fitness

The outcomes - goats





Ongoing

- **Sensitivity analysis**
- **Estimate monetary value of resilience**
  - **Losses in growth/milk production due to lack of performance stability**
- **Literature - Milk yield**
  - **£<1 – 5 / dairy ewe**
  - **£10 – 90 / dairy cow**
- **Identify optimum strategy**
  - **Possibly 10-20% emphasis on resilience**

Discussion points

- Is it worth considering these new traits?
  - No need to collect new animal data
  - Need for additional analyses (software available)
- Direction of selection
  - Breeding for performance stability
  - Breeding for positive reaction?
    - Increased temperature vs. temperature volatility
- Experience/thinking in other regions/countries
  - How do breeding goals evolve?
- Breeding for the future in view of other challenges
- Industry uptake