



The right cow for alpine pastures:

How performance breeding affects the sustainability and animal welfare of dairy cows in high-altitude rangelands

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Agroscope, Switzerland





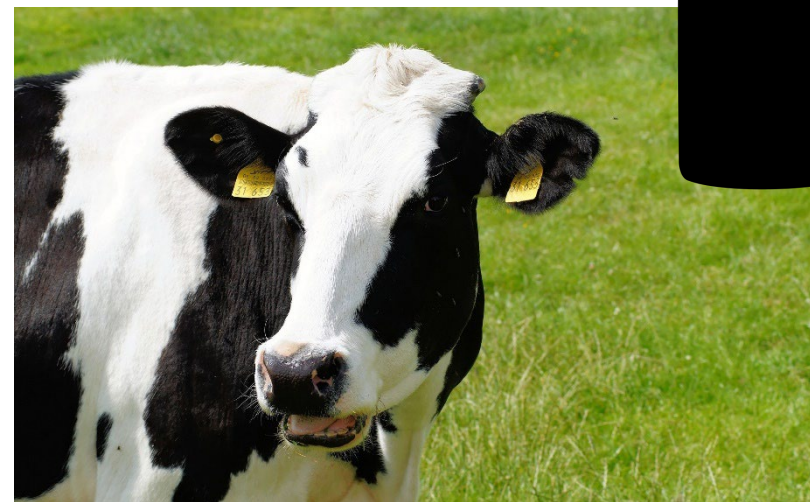
Performance breeding

Local / traditional breeds
(multiple purpose)



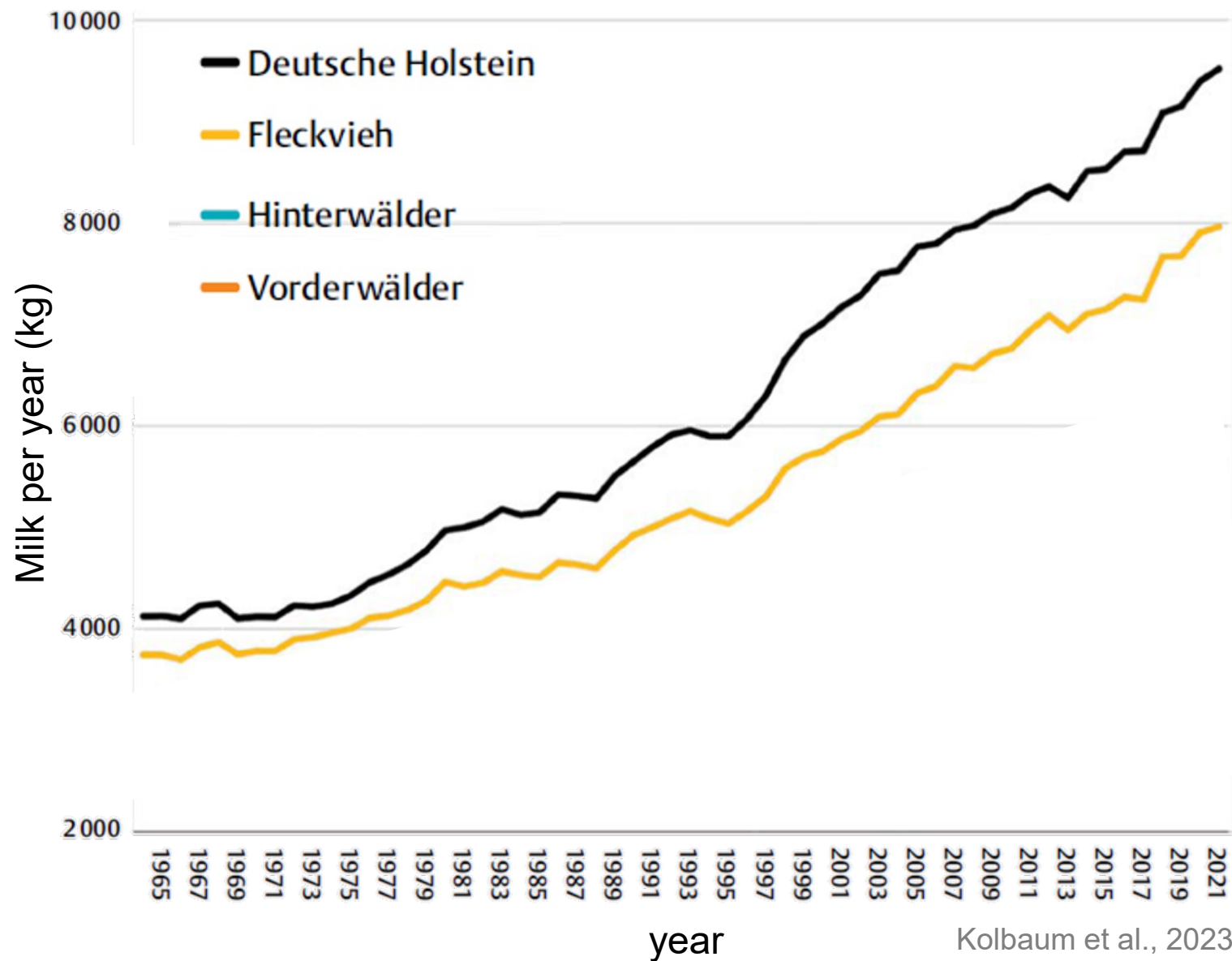
**Breeding =
performance testing
+ targeted selection**

Commercial breeds
(dairy or beef breeds)





Breeding increased productivity



Kolbaum et al., 2023



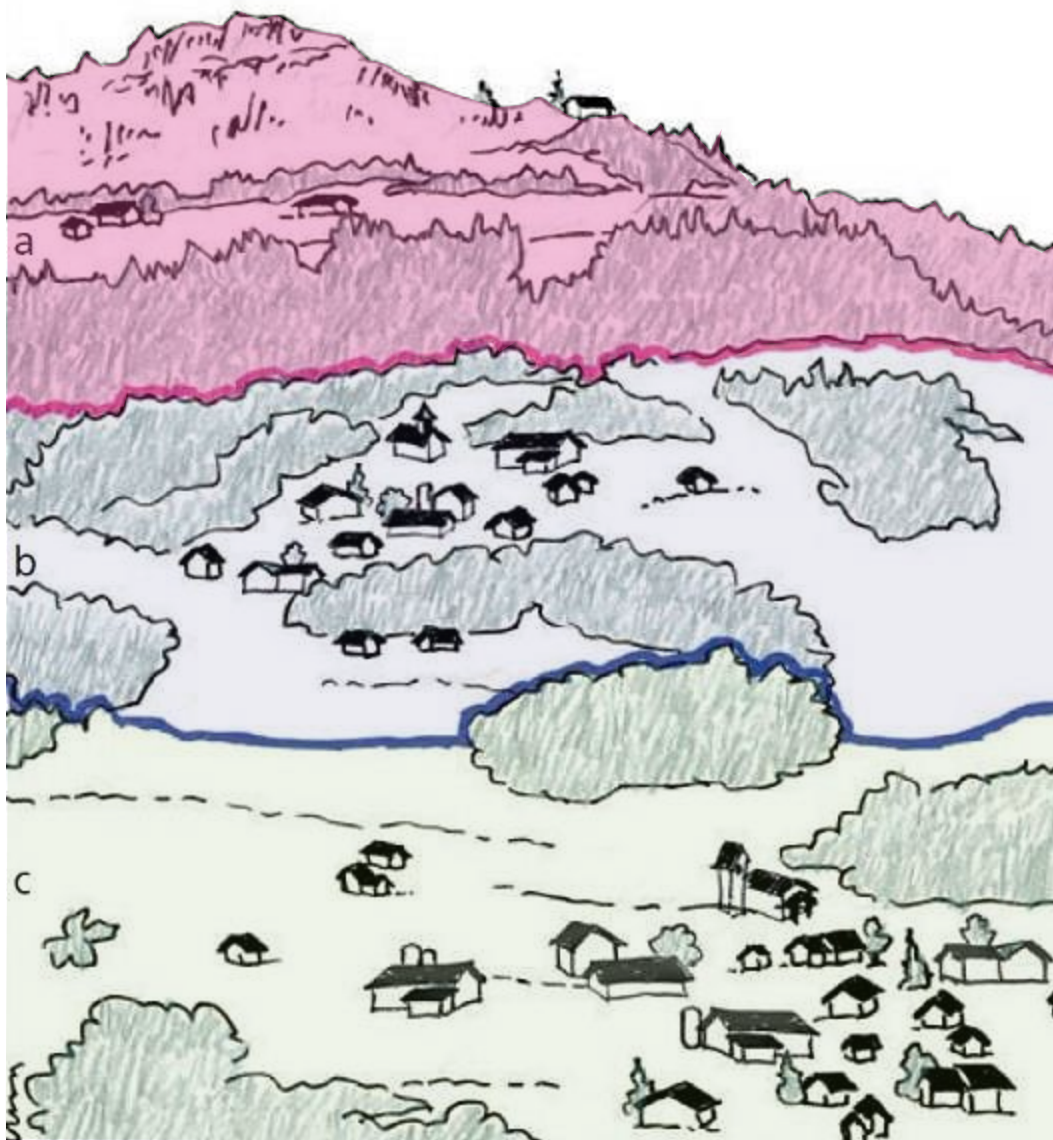
Holstein Friesian: ~10,000 kg / a



Hinterwälder: ~3,500 kg / a



From the valley to the mountains



Subalpine / alpine zone

- Rough environmental conditions and topography
- No arable farming; pasture as only agricultural option
- Rangelands: less biomass per ha → long distances to cover, low forage quality

Montane zone

- Environmental conditions less favorable
- Arable farming only to limited extent

Colline zone / valley

- Favorable environmental conditions
- Arable farming → concentrate feed
- Grasslands with high forage quality



Study design – location

- Alp Weissenstein
- Managed by Strickhof
- Albula pass
- 2000 m a.s.l.

Probably the only place in the world to conduct such an experiment.





Study design – model breeds

Productivity



Holstein

- Highly productive dairy breed
- Most common cattle breed – worldwide and in Switzerland
- Cow: 650-750 kg



Original Brown

- Dual-purpose breed
- Symbol of traditional mountain farming
- Cow : 600-700 kg



Hinterwälder

- Low-productive robust breed
- Hardly modified by modern performance breeding
- Cow: 350-450 kg



Study design – animals

Productivity

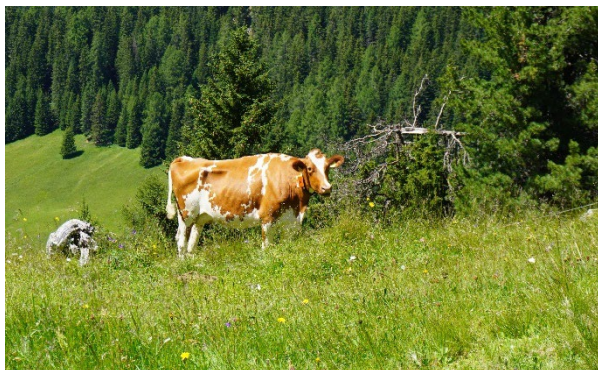


- 3 model breeds
- 3 rotations
- In each rotation:
 - 5 Holstein
 - 5-6 Original Brown
 - 7 Hinterwälder
- Mainly middle and late lactating cows
- Age: representative for respective breed population in Switzerland



Study design – pastures

Productivity



Pasture 1

- good forage quality
- $\pm$ flat



Pasture 2

- medium forage quality
- steep and flat parts



Pasture 3

- poor forage quality
- flat and steep parts

+ pool herd

Holstein	Hinterwälder	Original brown





Plant proportions before and after grazing: Qualitative forage selection



Video observation: movement in steep slopes



Body condition score: Energy balance



Herbometer: Quantitative forage consumption

Welfare

Cows
in the
Alps

Ecology

Productivity



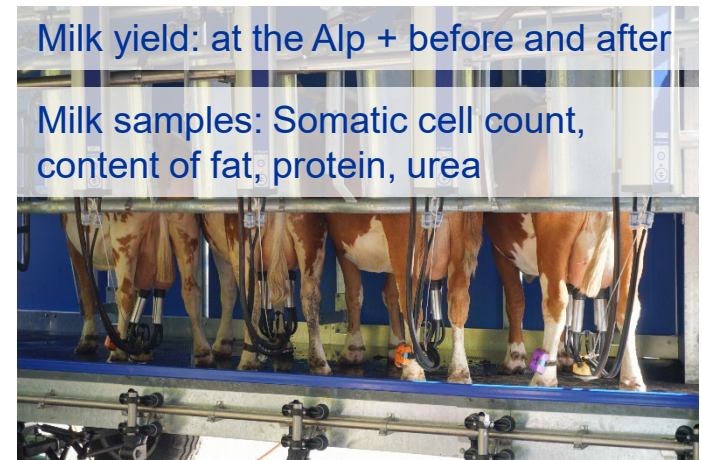
Body weight change



Greenfeed: Actual methane production



GPS tracking: Space use evenness, impact of slope, vegetation type, ...



Milk yield: at the Alp + before and after

Milk samples: Somatic cell count, content of fat, protein, urea



Veterinary examination:
General health status

Urine tests:
Ketosis

Pedometer:
step count and laying behavior

Direct observations:
social interactions and behavior

Blood samples:
Energy status (glucose) and stress (cortisol)

Plant proportions before and after
grazing: Qualitative forage selection

Video observation: movement in steep
slopes

Body condition score:
Energy balance

Herbometer: Quantitative forage
consumption

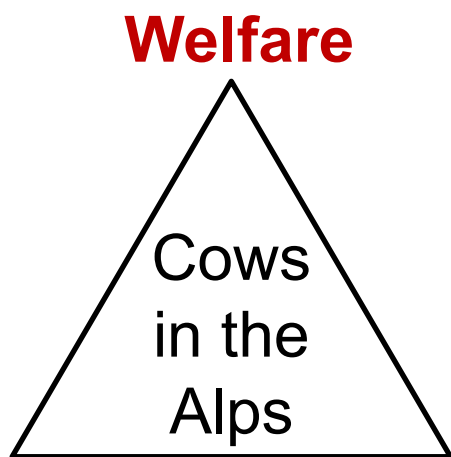
Body weight change

Milk fatty acid profile:
Indirect measure of methane emission

Body measures:
i.a., body length, depth, height, leg length, ...

TVD data of Identitas:
Population age, reason for slaughtering, ...

Ecology



Productivity

Greenfeed:
Actual methane production

GPS tracking: Space use evenness,
impact of slope, vegetation type, ...

Milk yield: at the Alp + before and after

Vegetation samples / Hohenheim Biogas Test:
Methane production potential

Vegetation samples:
Forage quality of all vegetation types

Milchproben: Zellzahlen, Fett-,
Protein-, Harnstoffgehalt

Vegetation samples of pure species:
Tannin content



Warning
Data analysis
just started –
not yet finished

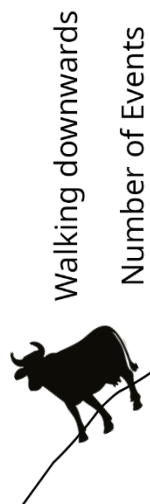




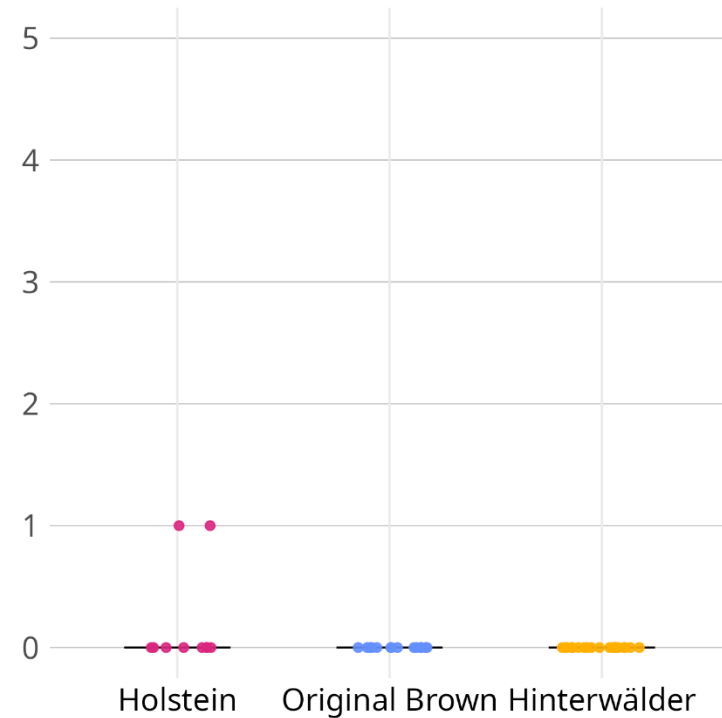
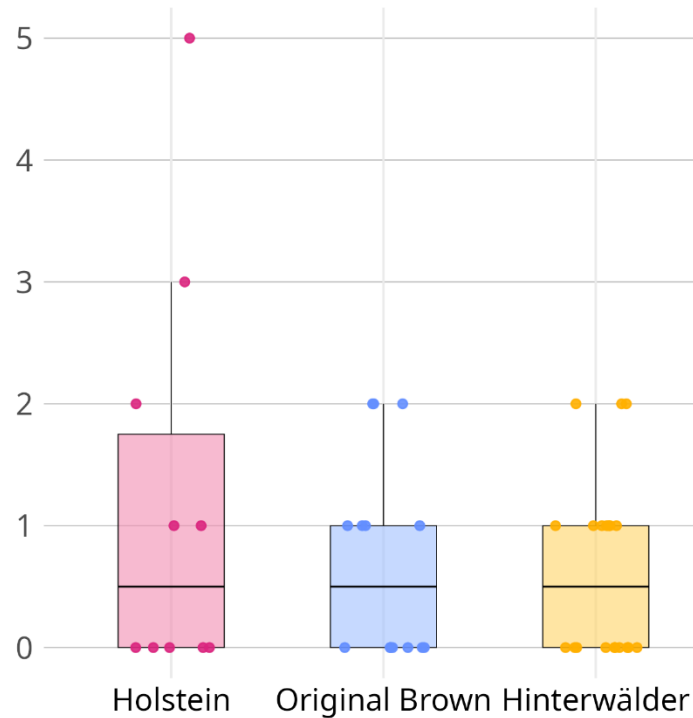
Missing leg control

Slipping

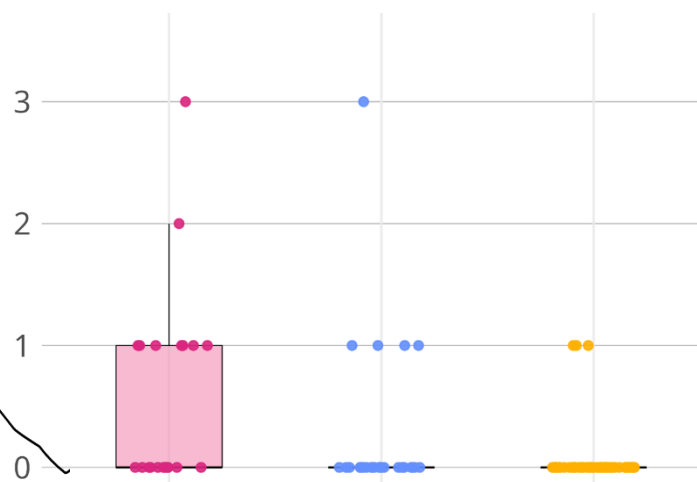
Falling



Walking downwards
Number of Events

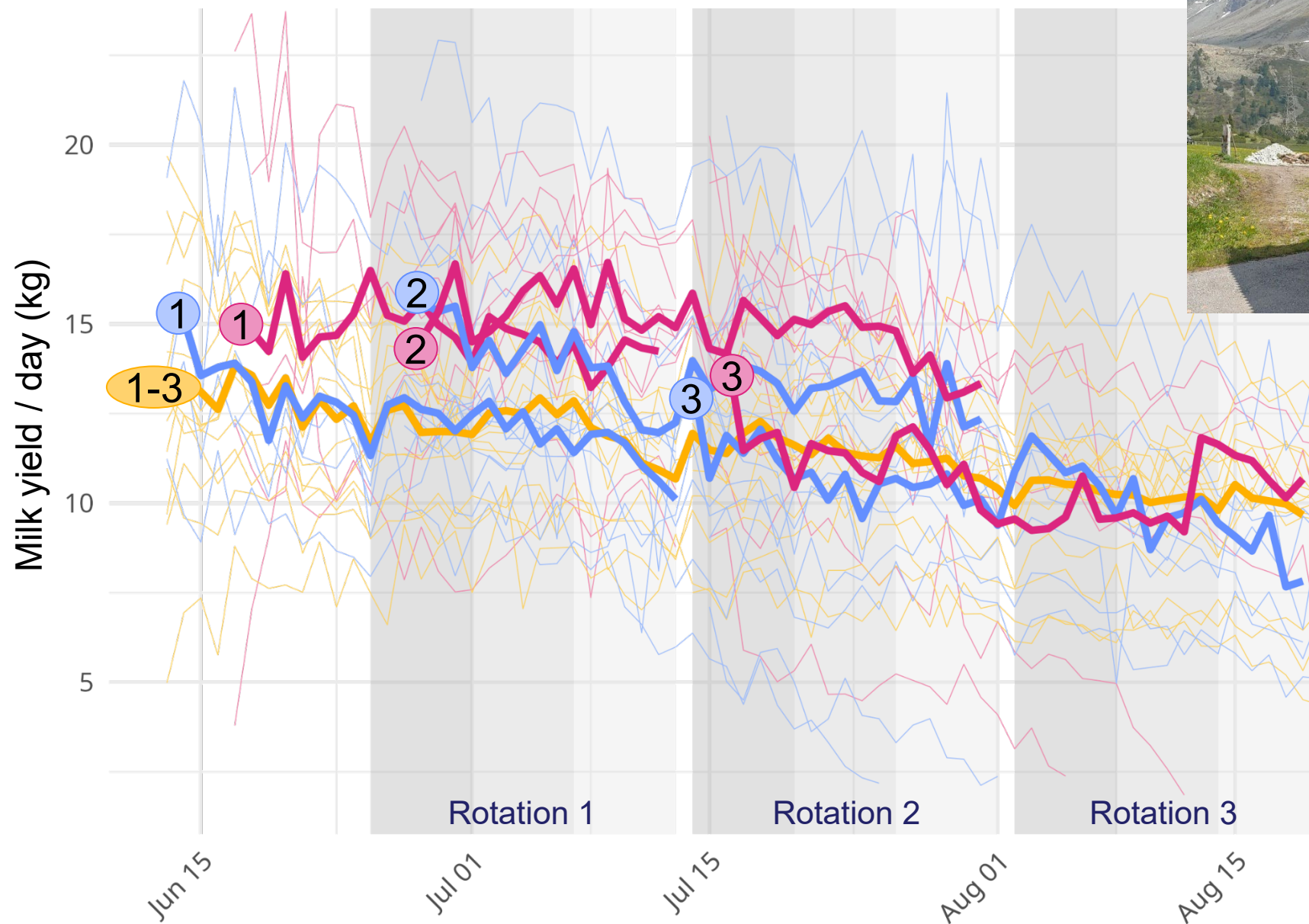


Walking upwards
Number of Events





Milk yield

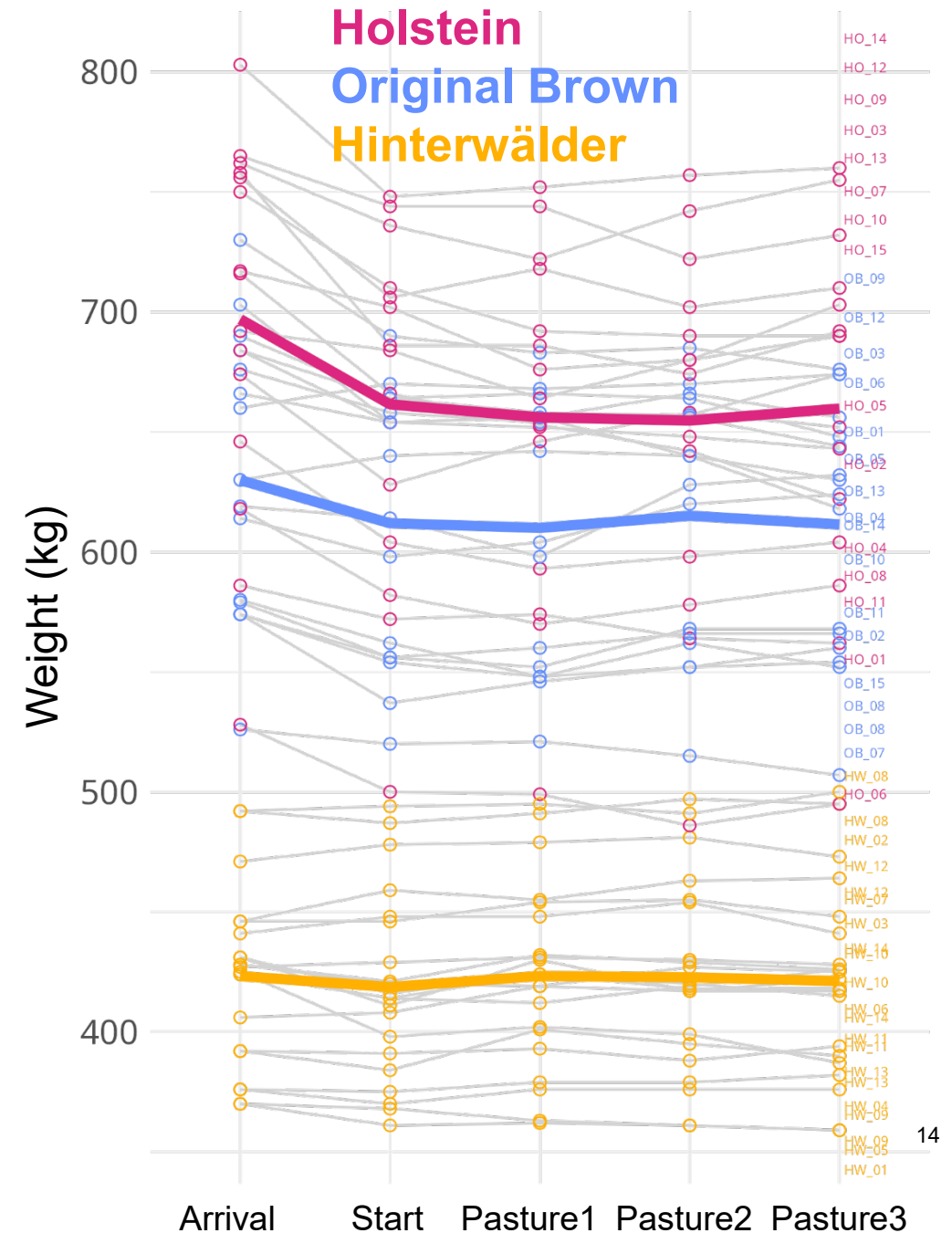


Holstein
Original Brown
Hinterwälder

Good forage quality
Medium forage quality
Poor forage quality

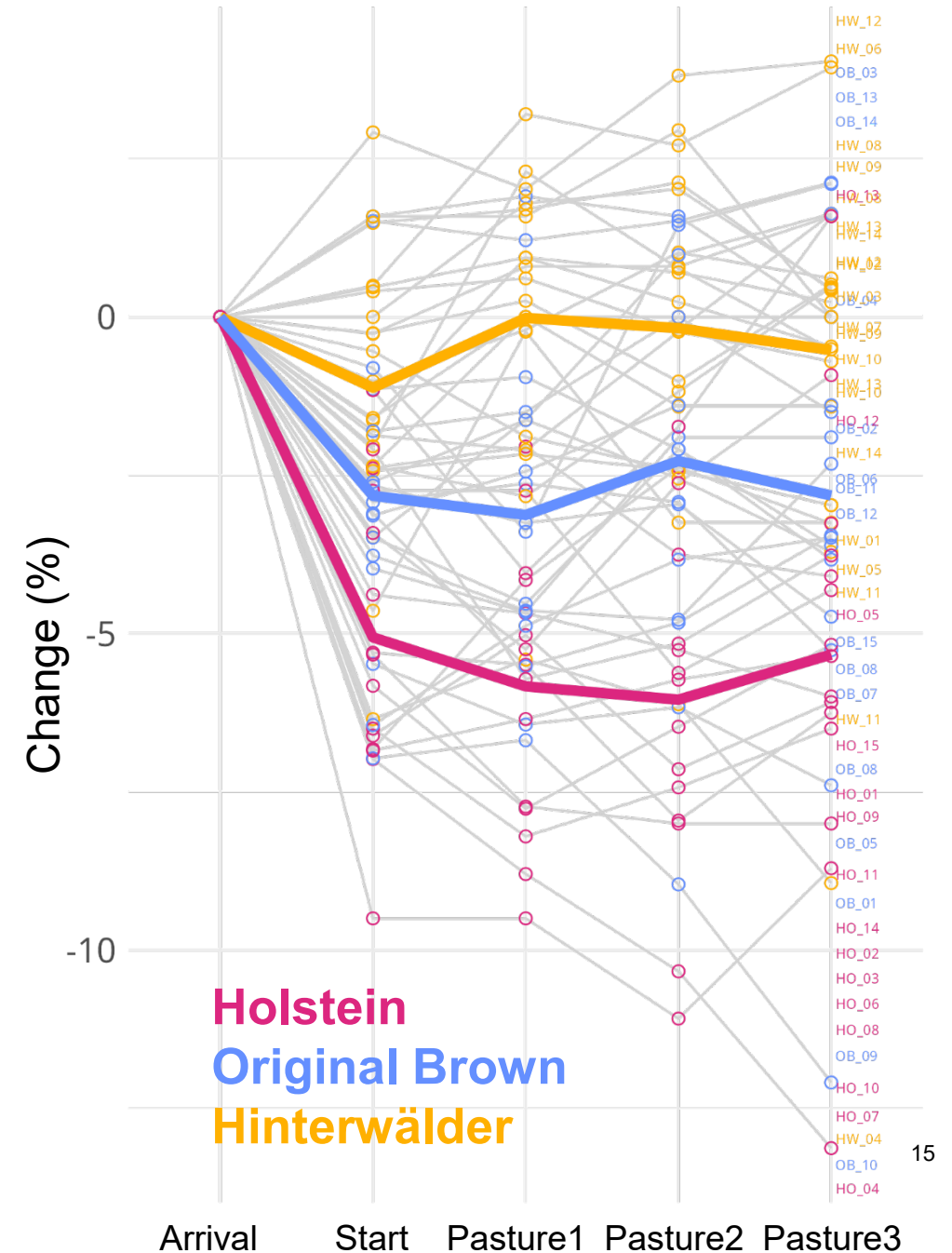
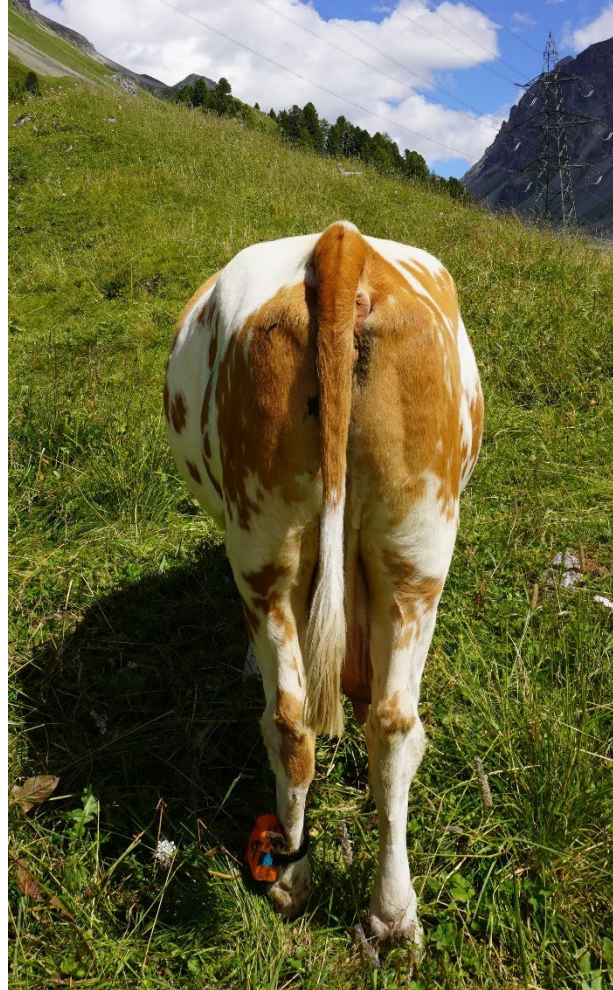


Body weight (absolute values)



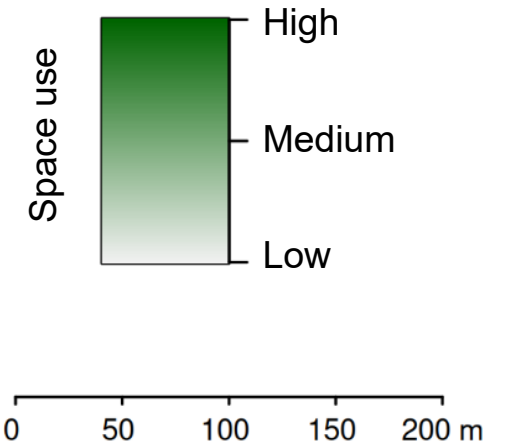
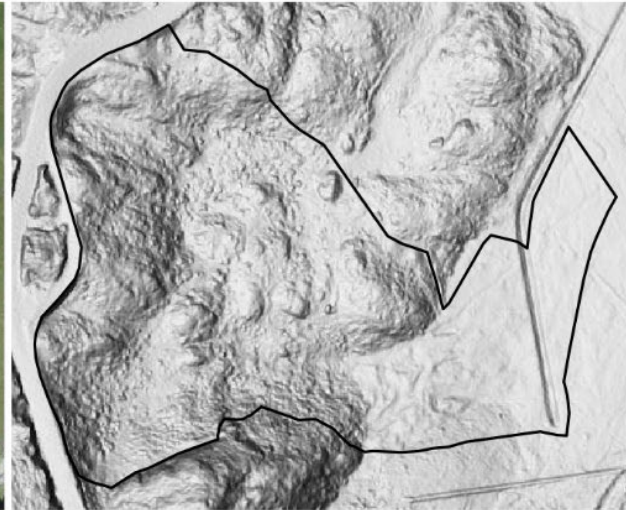


Body weight (percentage change)

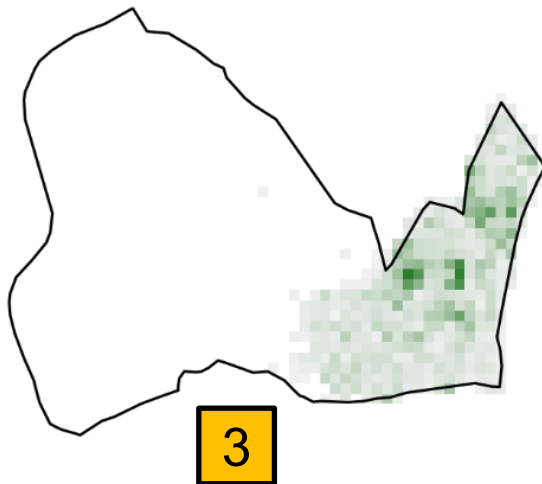




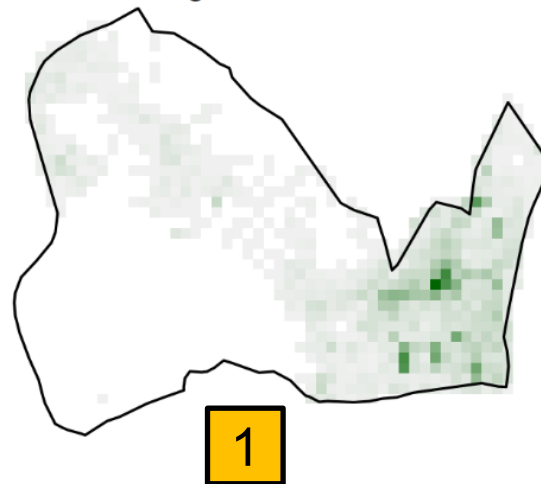
Space use



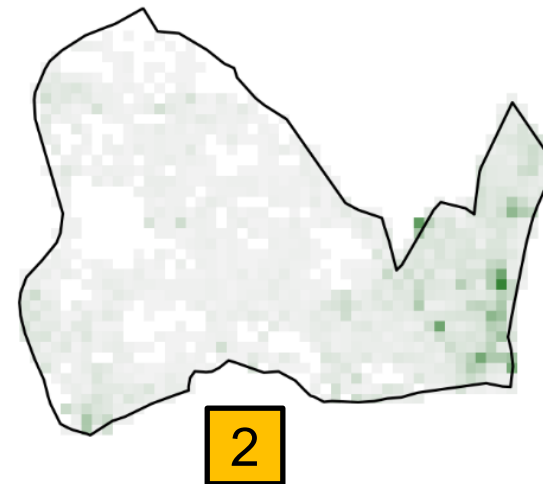
Holstein



Original Braunvieh

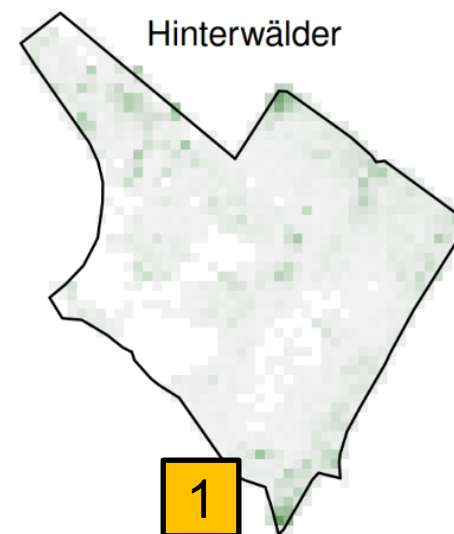
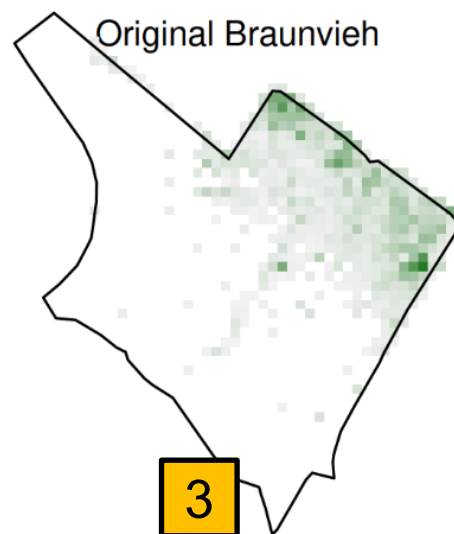
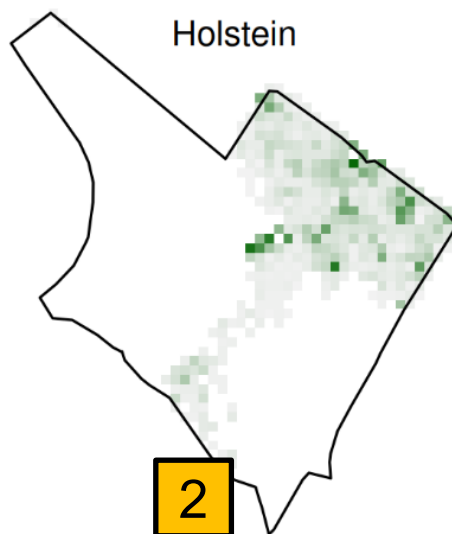
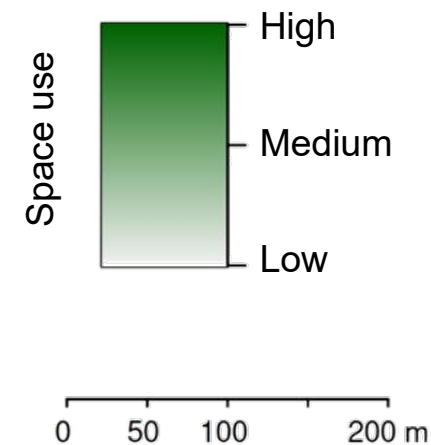


Hinterwälder





Space use





Lili
10 years
14 l/day



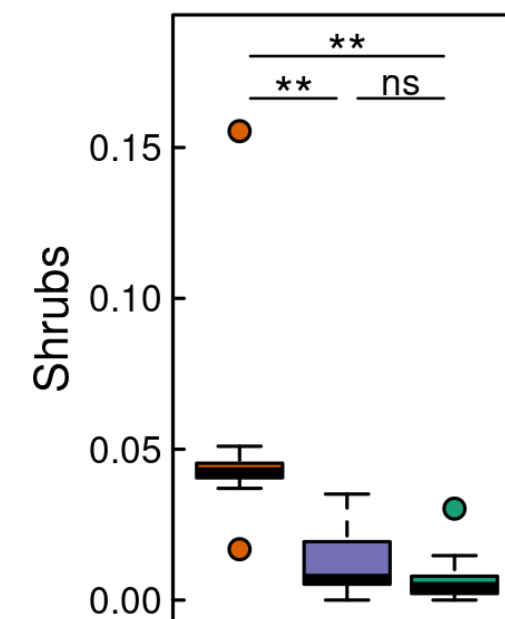
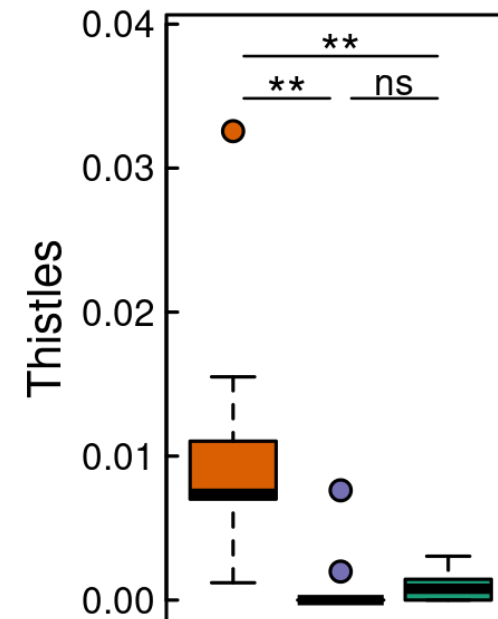
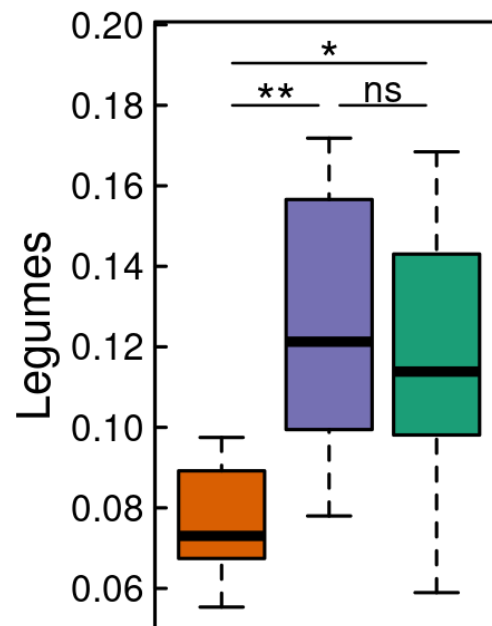
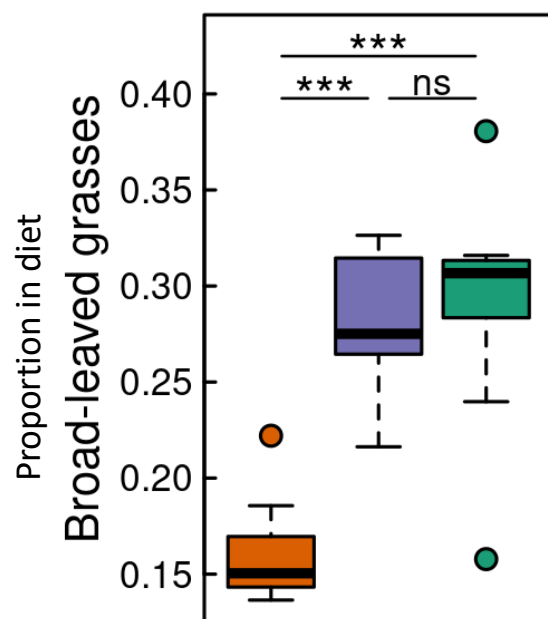
Differences in forage selection

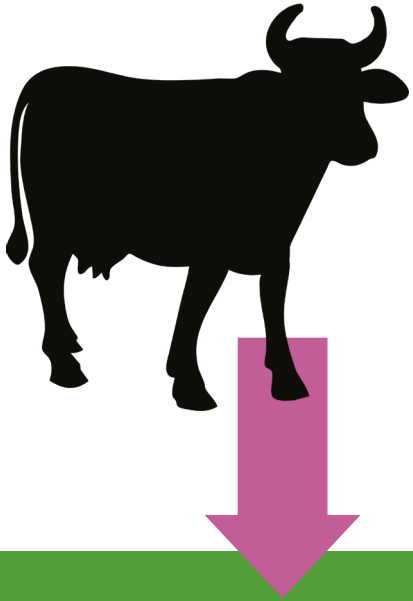


Differences in forage selection

Pauler et al., 2020

Highland cattle (low-productive) Original Brown (medium productive) Angus × Holstein (high-productive)





Semi-natural grasslands

Ecosystem services:
biomass production, biodiversity, for recreation and tourism...



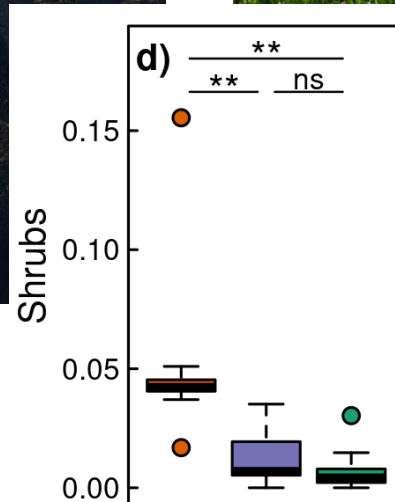
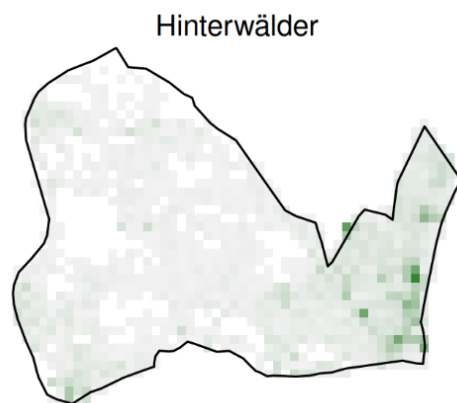
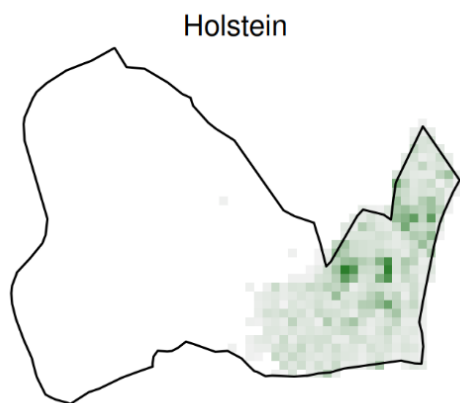
In ancient times...





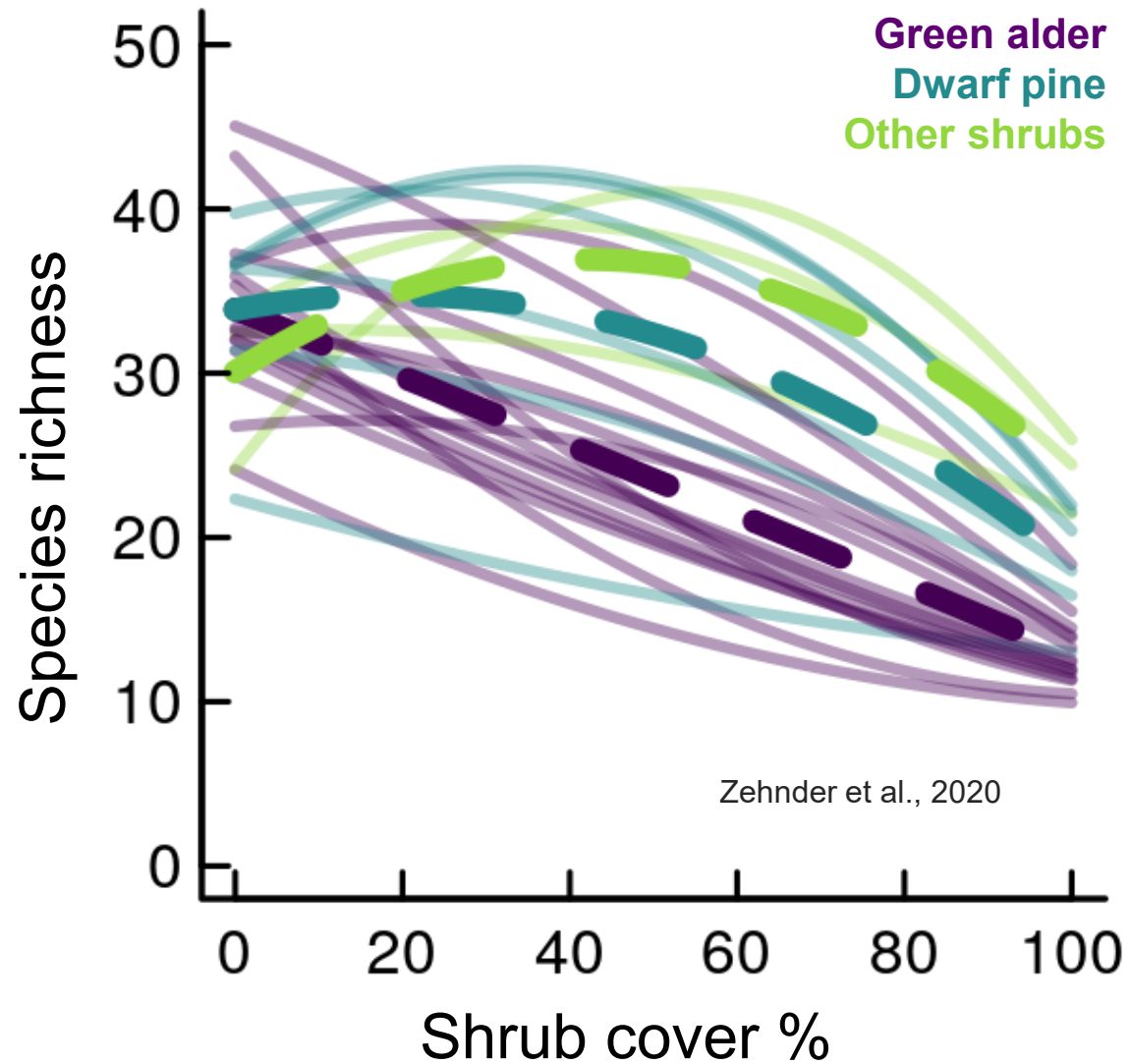


Forest / shrubs → open grasslands





Consequences of shrub invasion





Preliminary conclusions

Intensive breeds seem to be less adapted to alpine pastures

- **Welfare:** Intensive breeds may face animal welfare issues on alpine pastures
- **Productivity:** Differences in productivity are less clear under alpine conditions
- **Ecology:** Long-term sustainability of alpine pastures depends on site-adapted animals





Thanks to our
great team and to
AgroVet-Strickhof





Looking for more mountain farming research?

SRF Einstein
documentary about
our experiment



Mountain ^{Grassland & Livestock}

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