


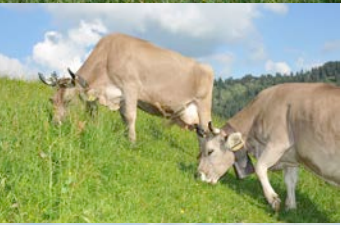


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Genotype x Environment Interactions in Dual Purpose Cattle in Harsh Environments

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Background

Dairy cattle is kept in various environments worldwide:

- Geographic/topographic/climate
  - Lowlands
  - Alpine regions with alpine summer pasture
  - Tropical/Subtropical/Temperate climate
  - …
- Production systems
  - TMR feeding systems
  - Pasture based feeding systems
  - Organic/conventional systems
  - …

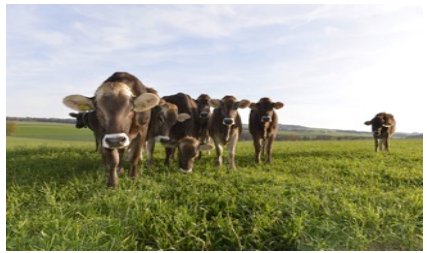
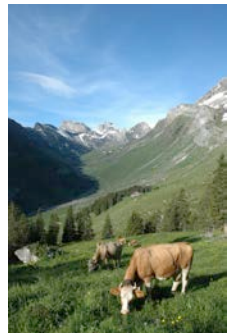
Background

Different cows:




Different environments:



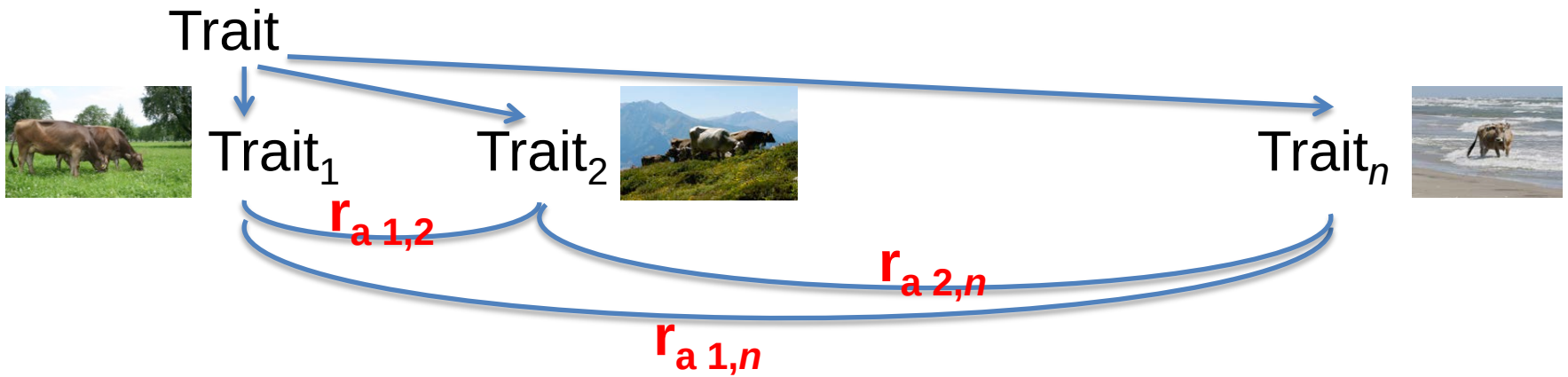



Interactions between specific environment and genotype (GxE Interactions)?

Concept

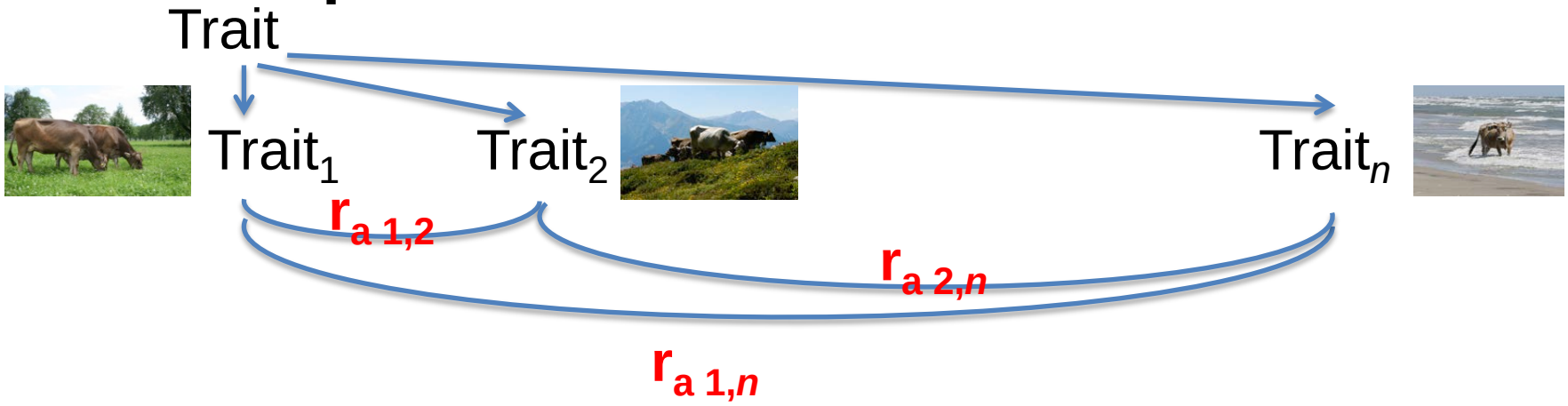
Multiple trait models

- Split a trait in *n* different other traits according to *n* defined environments
- Estimate the genetic correlations (r_a) between the traits



Concept

Multiple trait models



- $r_a = 1$ → No GxE interactions
- $1 > r_a > 0.8$ → Weak GxE interactions
- $r_a < 0.8$ → Strong GxE interactions

Model

- Multiple trait animal model with repeated measurements
- REMLF90
- Traits: Milk kg, fat kg and protein kg
- Stepwise model development

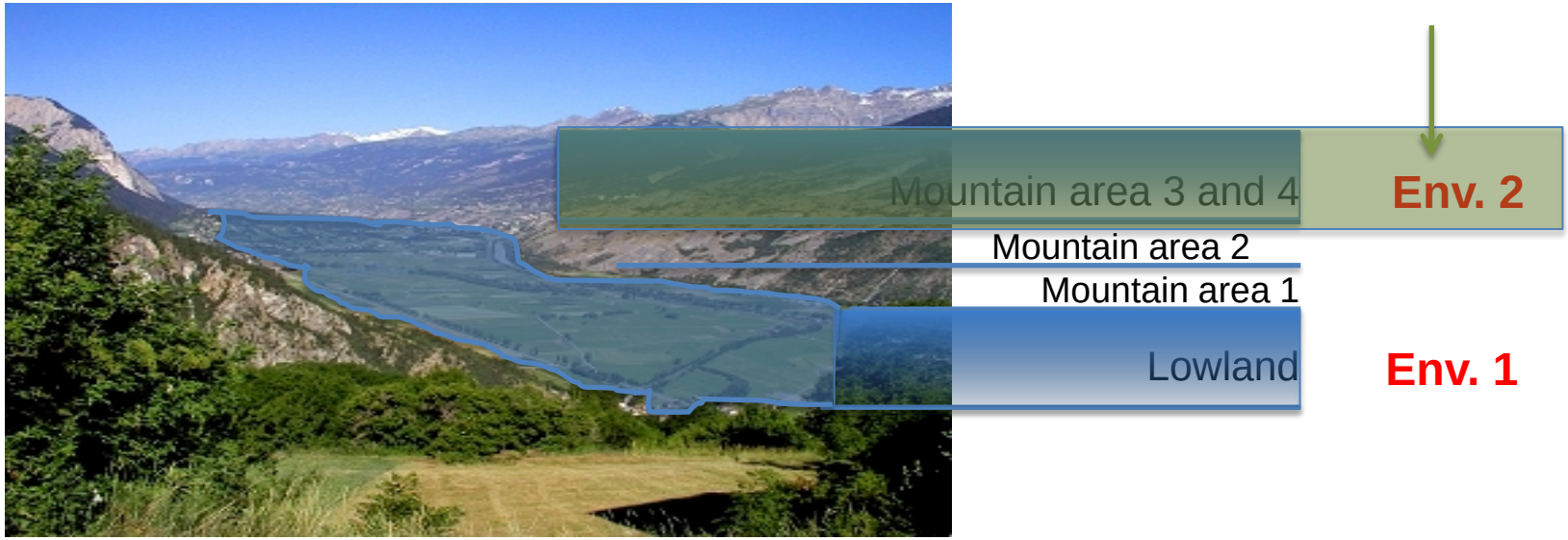
Model

Effect	Type	Trait	
		Environment 1	Environment 2
*Herd * Year*	random	Mkg, Fat, Prot.	Mkg, Fat, Prot.
*Calving Year * Season*	fixed	Mkg, Fat, Prot.	Mkg, Fat, Prot.
Lactation	fixed	Mkg, Fat, Prot.	Mkg, Fat, Prot.
additiv genet. effect of animal	random	Mkg, Fat, Prot.	Mkg, Fat, Prot.
Permanent environment	random	Mkg, Fat, Prot.	Mkg, Fat, Prot.
Residual	random	Mkg, Fat, Prot.	Mkg, Fat, Prot.

Concept

2 Opposed environments/farms:

Scenario FA: Farm altitude



Concept

2 Opposed environments/farms:

Scenario FS: Farming system

Harsh env.

Conventional	Organic
	**Restrictions:** • Amount of concentrates • Health management • Application of breeding technologies • …

Concept of the current analysis

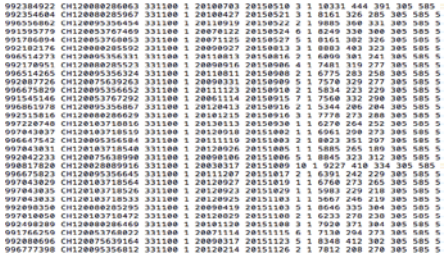
Different type of cows	Different types of environments conv/**organic** lowland/**mountain**

GxE?

Difference?

GxE?

Data



OB: 104,984 standard lactations (35,614 cows)
BS: 2,113,959 standard lactations (753,667 cows)

- 2000 – 2015
- Traits: Milk kg, fat kg and protein kg
- Restrictions: Test days only on the same farm during lactation, cows from lowland with summer alpine pasture were excluded
- Phenotypic key figures:

Year	OB			BS		
	Milk kg	Fat kg	Prot. kg	Milk kg	Fat kg	Prot. kg
2000	5677	213	184	6342	251	210
2015	6066	238	201	7197	290	244

Farm altitude

Mountain area

Lowland

Heritabilities (diagonal elements) and genetic correlations, r_a for *OB* / BS:

	Milk kg 1	Fat kg 1	Prot. kg 1	Milk kg 2	Fat kg 2	Prot. kg 2
Milk kg 1	0.33 / 0.27					
Fat kg 1	0.85 / 0.78	0.23 / 0.20				
Prot. kg 1	0.87 / 0.82	0.86 / 0.83	0.24 / 0.18			
Milk kg 2	**0.99 / 0.99**	0.85 / 0.78	0.86 / 0.81	0.30 / 0.23		
Fat kg 2	0.83 / 0.74	**0.99 / 0.99**	0.87 / 0.82	0.83 / 0.74	0.26 / 0.22	
Prot. kg 2	0.89 / 0.82	0.85 / 0.81	**0.99 / 0.99**	0.88 / 0.83	0.86 / 0.80	0.28 / 0.22

Farming system

conventional / organic

Heritabilities (diagonal elements) and genetic correlations, r_a for *OB* / BS:

	Milk kg 1	Fat kg 1	Prot. kg 1	Milk kg 2	Fat kg 2	Prot. kg 2
Milk kg 1	0.29 / 0.26					
Fat kg 1	0.82 / 0.76	0.24 / 0.20				
Prot. kg 1	0.82 / 0.85	0.85 / 0.83	0.19 / 0.17			
Milk kg 2	**0.99 / 0.99**	0.82 / 0.76	0.82 / 0.82	0.27 / 0.21		
Fat kg 2	0.78 / 0.71	**0.99 / 0.99**	0.85 / 0.80	0.78 / 0.71	0.24 / 0.18	
Prot. kg 2	0.85 / 0.85	0.85 / 0.80	**0.99 / 0.99**	0.85 / 0.84	0.84 / 0.77	0.26 / 0.22

- GxE interactions do not exist for yield traits between common and harsh environments for OB and for BS dairy cattle
- OB and BS do not react differently to harsh environments
- Confirmation of earlier investigations for Swiss populations: r_a 0.96-0.98 for yield traits in conventional and organic environments
  (Bapst et al., 2007 in Simianer, 2007)
- Other investigations show similar results, partly with slightly stronger GxE interactions
  (e.g. Pfeiffer et al., 2016; Cole, 2015; Streit et al., 2012)
- Stronger reactions were found in more contrasting environments: e.g. South Africa (Neser et al., 2014)

→ No need for action for the breeding program and for genetic evaluation

But:

- Establish different environment definitions

- Test other methods/models/breeds (SI versus HO/RH)

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Thanks for your attention

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