DIFFERENCES IN GRAZING PREFERENCES, BEHAVIOUR AND PRODUCTION EFFICIENCY BETWEEN TWO CATTLE BREEDS

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BLACKSIDED TRØNDER AND NORDLAND CATTLE
SIDET TRØNDERFE OG NORDLANDSFE
(STN)

NORWEGIAN RED
NORSK RØDT FE
(NRF)

Photo: Geno

LIST OF PAPERS

- Paper I

  Motives for utilizing the Blacksided Trønder and Nordland: A native cattle breed in Norway. Sæther, N.H., Vangen, O., 2001. Animal Genetic Resources Information 31, 15-26.

- Paper II

  Differences in grazing behaviour between a high and a moderate yielding Norwegian dairy cattle breed grazing semi-natural grasslands. Sæther, N.H., Bøe, K.E. & Vangen, O. 2006. Acta Agriculturae Scand Section A, 56: 91-98.

- Paper III

  Plant and vegetation preferences for a high and a moderate yielding Norwegian dairy cattle breed grazing semi-natural grasslands. Sæther, N.H., Sickel, H., Norderhaug, A., Sickel, M. & Vangen, O. 2006. Animal Research, 55: 367-387.

- Paper IV

  Differences in energy balance and energy efficiency between an old endangered and a modern Norwegian dairy cattle breed in a traditional indoor feeding system. Sæther, N.H., Havrevoll, Ø., Thuen, E. & Vangen, O. Accepted for publication in Acta Agriculturae Scand Section A.

OUTLINE

- Overall motivation
- Presentation of the two studied breeds
- Objectives

  – *Why do farmers choose the old and endangered STN breed?* (Paper I)

Differences between STN and NRF in

  – *production efficiency* (Paper IV)

  – *grazing behaviour* (Paper II)

  – *grazing preferences* (Paper III)

MOTIVATION FOR THE STUDY

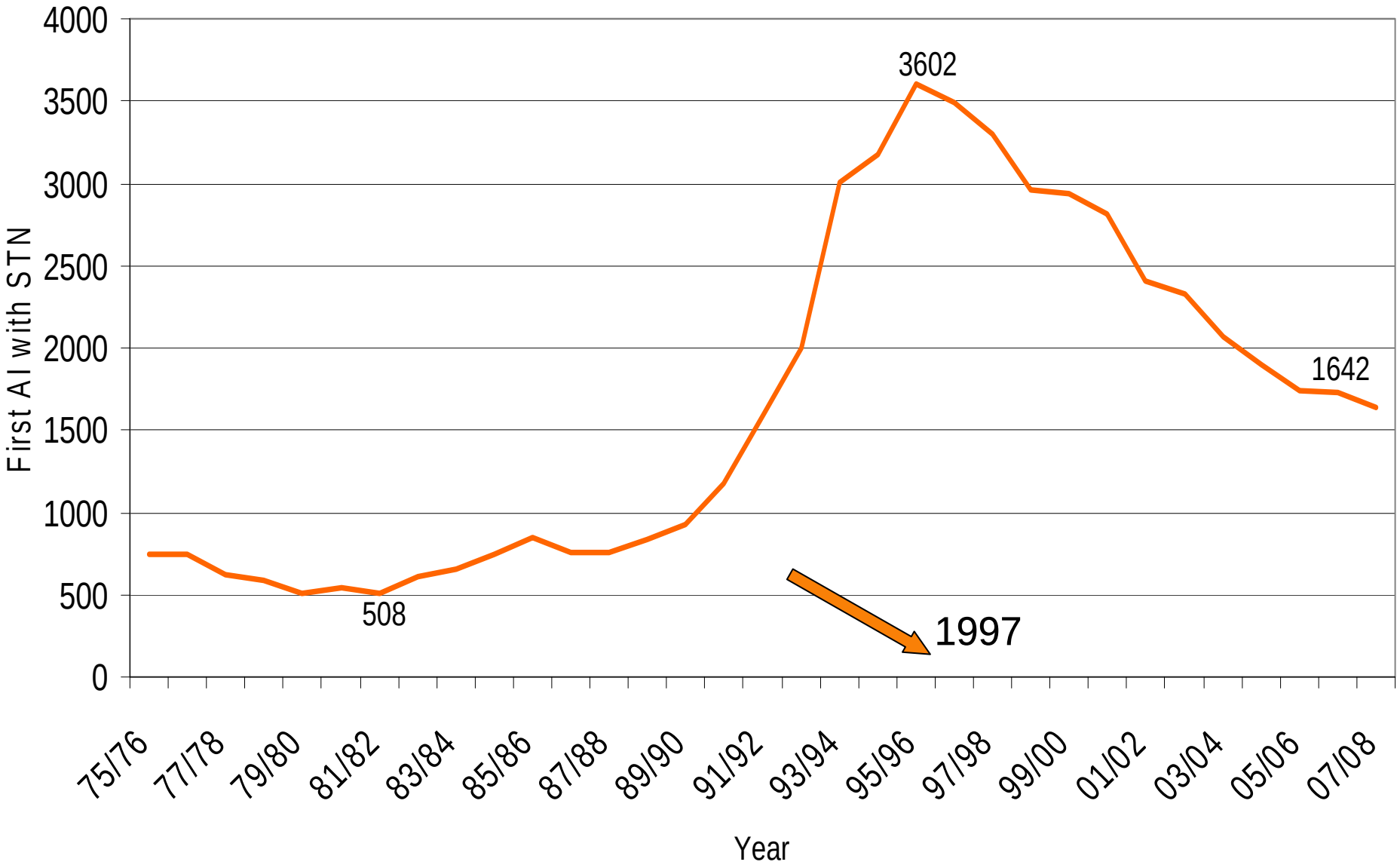
- A broad historical outline of Norwegian animal breeding
  - 1960s: seven native dairy breeds merged to one, NRF
  - 1970s: the six abandoned breeds almost forgotten
    NRF's breeding programme intensifies
  - 1980s: a growing interest for the abandoned breeds
    - Official authorities
    - Farmers
- Why where the farmers interested in the abandoned breeds?
  - unique traits?
  - historical reasons?

SIX ABANDONED DAIRY BREEDS – WHY WAS STN CHOSEN?

- STN had
  - the biggest population
  - a breeding association

→ Best conditions for good data and test animals

NUMBER OF FIRST INSEMINATIONS WITH STN 1975-2008



THE TWO STUDIED BREEDS

Breed	STN	NRF
Origin	*Native*	*Native*
Incidence	*Endangered*	*97 % of all dairy cows*
Population size	*1 000 cows*	*240 000 cows*
Breeding goals	*Pure breeding* *Avoidance of inbreeding* *Milk production* *Breed type*	*Milk and meat yield* *Health and fertility traits*

DEVELOPEMENT IN MILK YIELD AND MILK COMPOSITION

Breed:	STN		NRF	
Trait **Year:**	**1953**	**2008**	**1953**	**2008**
Annual milk yield, kg	2 600[1]	4 200[2]	3 600[1]	7 100[2]
Fat content in milk, %	4.1[1]	4.3[2]	3.9[1]	4.2[2]
Protein content in milk, %	nd	3.3[2]	nd	3.4[2]
Genetic trends				
Protein yield 1978-1998	nd		0.63 kg/yr[3]	
Fertility 1978-1998	nd		0.14 %/yr[3]	
Clinical mastitis 1990-1998	nd		- 0.27 %/yr[4]	

nd= no data

[1] Korkman, 1953

[2] Tine, 2009

COMENTS TO THE DEVELOPMENT IN PRODUCTION CAPACITY

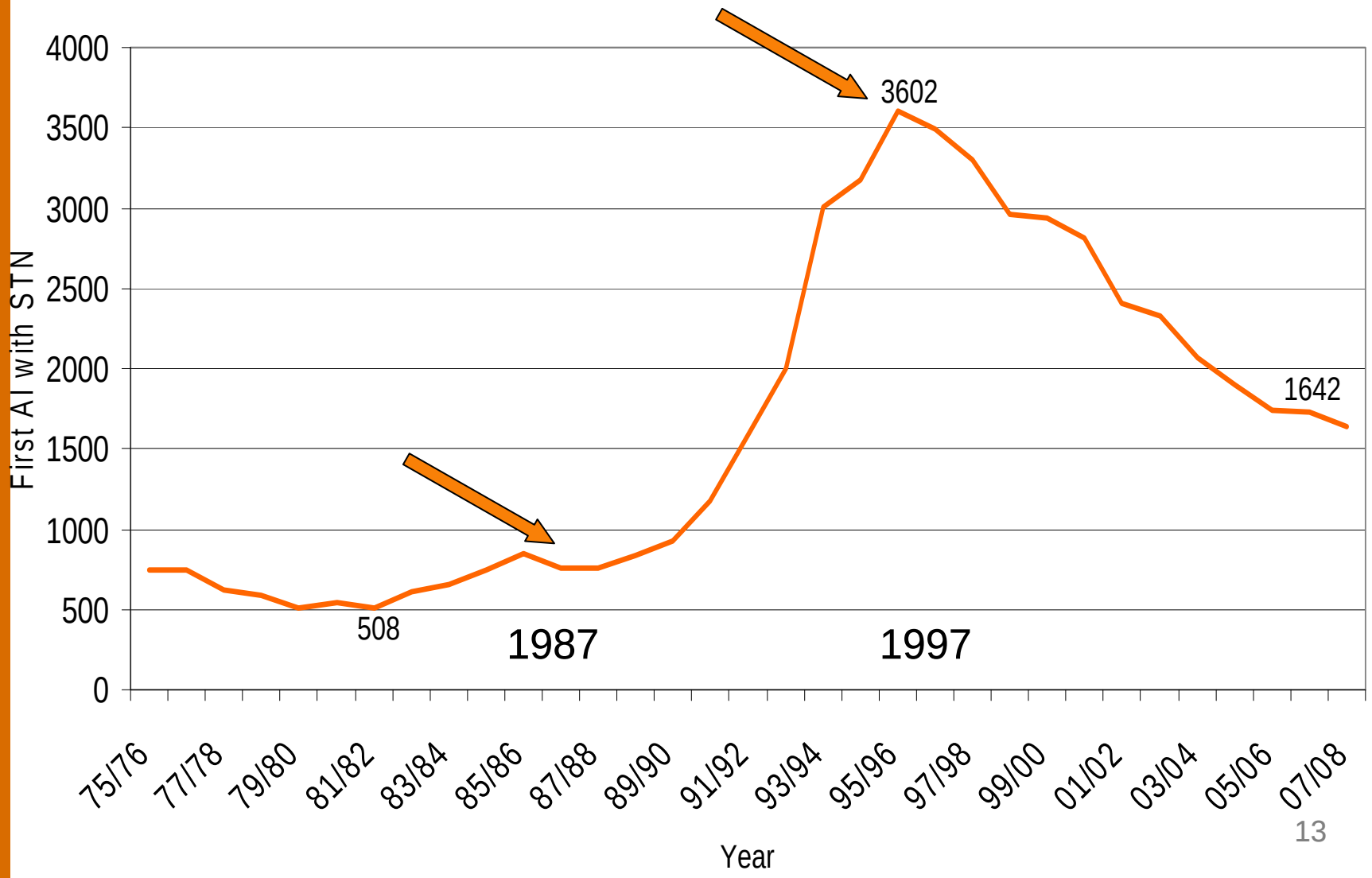
- Different selection histories since the 1960s

- Genetic trends:
  - STN
    - unchanged genetic level for most traits?
  - NRF
    - increased production capacity
    - improved fertility
    - decrease in clinical mastitis

WHY DO FARMERS CHOOSE THE OLD AND ENDANGERED STN BREED? (Paper I)

- Survey asking farmers about
  - Motives for using STN
  - Expectations to STN
  - Experiences with STN
- A questionnaire to 1 722 farmers that had inseminated with STN 1987-1997
- Response rate: 25.6 % (441 answers)
  - 237 non-experienced STN farmers
  - 162 experienced STN farmers

NUMBER OF FIRST INSEMINATIONS WITH STN 1975-2008



RESULTS FROM THE QUESTIONNAIRE

- Motives for using STN
  - Conserving an alternative dairy breed: 70 %
  - Other motives: 50 %
  - Conserving a genetic resource: 45 %
  - Historical: 20 %
  - Challenging breeding strategy: 20 %

FROM THE QUESTIONNAIRE

- Expectations more or less = experiences

- Expectations to STN compared to NRF:
  - conformation:
    - lower live weight, nicer colour, more polled animals
  - production:
    - lower milk yield, higher fat and protein content in milk
    - higher culling age, easier heat detection
    - same health status
  - same net income
  - grazing:
    - less trampling damage to pastures
    - better on extensive pastures

THREE STUDIES TO TEST BREED DIFFERENCES

- Production study (Paper IV)
  - Traditional production traits
  - Energy balance
  - Energy efficiency
- Grazing studies on extensive pastures
  - Grazing behaviour (Paper II)
  - Grazing preferences (Paper III)

PRODUCTION STUDY (Paper IV)

- Overall design:
  - Comparing STN and NRF in the same herd
  - Ten cows in each group of breeds
    - three primiparous
    - seven multiparous
  - Week 1 - 44 of lactation, three indoor feeding seasons
  - Recording frequencies:
    - Every week: Feed intake, milk yield, milk quality
    - Every month: Feed quality, live weight, body condition score

CHOICE OF FEEDING SYSTEM AND FEED INTENCITY

- Feeding system
  - Perfect setting: Total mixed ration
  - Chosen feeding system:
    - roughage ad lib
    - restricted amount of concentrates

- Feeding intensity
  - Goal: *The same level of feed concentration and nutrition level according to live weight and level of production*

  - STN: 3 700 kg milk 440 kg live weight
  - NRF: 6 700 kg milk 540 kg live weight

CHOICE OF FEEDING INTENSITY

- STN:
  - 65 % of NRF's production level
  - 80 % of NRF's live weight
- Milk production requires 2/3 of utilized energy, maintenance requires 1/3 (Korver, 1988)
- STN was given 60 % of NRF's level of concentrates
- Roughage quality
  - 0.81 Feed Unit Milk/kg dry matter

EFFECTS AND TRAITS

EFFECTS

- Breed
- Lactation number (1, 2)
- Test month (1-18)
- Lactation month (1-11)
- Breed x lactation month
- Random effect of cow

TRAITS

- Feed intake
- Milk yield
- Milk quality
- Live weight
- Live weight change
- Body condition score (1=very thin, 5=very fat)
- Energy balance and energy efficiency parameters

ABBREVATIONS

- MJ = mega joule
- NE_l = net energy for lactation
- ME = metabolizable energy

ENERGY BALANCE AND ENERGY EFFICIENCY

- *Energy Balance* =

  NE_l from feed intake –

  (NE_l in produced milk + NE_l required for maintenance)

- *Gross energy efficiency* =

  NE_l in produced milk /

  MJ ME from feed intake

- *Partial energy efficiency for lactation (k_l)* =

  NE_l in produced milk / MJ ME available for milk production[1]

[1]MJ ME available for milk production =

MJ ME from feed intake – MJ ME required for maintenance

+/- MJ ME body tissue gain or loss

RESULTS – PRODUCTION AND ENERGY EFFICIENCY

Trait	N	Breed	Lact. no.	Test month	Lact. month	Breed x lact. month	cow	STN LS-means	NRF LS-means
ME intake (MJ/day)	624	**	**	**	**	**	**	104	161
Energy corrected milk (kg/day)	887	**	**	**	**	-	**	11.3	22.6
Milk fat (%)	913	-	-	**	**	-	**	4.33	4.22
Milk protein (%)	913	**	-	**	**	-	**	3.40	3.17
Live weight (LW), kg	172	**	**	**	**	-	**	439	561
LW change, kg/day	103	-	-	**	-	-	-	0.32	0.41
Body condition score	188	*	-	**	**	*	**	2.80	2.59
Energy balance, MJ NE_l	94	-	-	**	**	-	-	-6.8	-12.7
Gross energy efficiency	612	**	*	**	**	**	**	0.39	0.48
Partial energy efficiency for lactation (k_l)	63	-	*	**	-	-	-	0.70	0.72

**1%, * 5%, - = not significant

RESULTS FROM PAPER IV

- NRF had significantly:
  - higher live weight
  - higher daily ME intake
  - higher milk yield
  - lower protein content
  - better gross energy efficiency
- No breed differences for
  - Live weight change
  - Energy balance
  - Partial energy efficiency for lactation
- Discrepancy
  - Negative energy balance ⟺ live weight gain

COMMENTS ON RESULTS FROM PAPER IV

- Discrepancy between
  - Negative energy balance

  - Live weight gain & positive body condition score

- WHY?
  - Measurements?
  - Calculations?
  - Feed evaluation system?

COMMENTS ON RESULTS FROM PAPER IV

- No breed difference:
  - Energy balance
  - Partial energy efficiency for lactation

- WHY?
  - No breed differences?
  - Lack of genetic variance in metabolism efficiency?

  - OR...

RESULTS – PRODUCTION AND ENERGY EFFICIENCY

Trait	N	Breed	Lact. no.	Test month	Lact. month	Breed x lact. month	cow	**STN**	**NRF**
[1]ME intake ([2]MJ/day)	624	**	**	**	**	**	**	104	161
[3]ECM (kg/day)	887	**	**	**	**	-	**	11.3	22.6
Milk fat (%)	913	-	-	**	**	-	**	4.33	4.22
Milk protein (%)	913	**	-	**	**	-	**	3.40	3.17
Live weight, kg	172	**	**	**	**	-	**	439	561
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Energy balance, MJ [5]NE_l	94	-	-	**	**	-	-	-6.8	-12.7
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COMMENTS ON RESULTS FROM PAPER IV

- No breed difference:
  - Energy balance
  - Partial energy efficiency for lactation

- WHY?
  - No breed differences?
  - Lack of genetic variance in metabolism efficiency?
  - Prediction parameters eliminate genetic variation?

THREE STUDIES TO TEST BREED DIFFERENCES

- Production study (Paper IV)
  - Traditional production traits
  - Energy balance
  - Energy efficiency
- Grazing studies on extensive pastures
  - Grazing behaviour (Paper II)
  - Grazing preferences (Paper III)

BREED DIFFERENCES IN GRAZING BEHAVIOUR & GRAZING PREFERENCES

- Motivated by the two breeds' different selection histories:
  - The resource allocation theory (Beilharz, 1993):

    "animals with high production capacity have lower activity level than animals with low yielding capacity"

EXTENCIVE PASTURES IN THIS STUDY

- Semi-natural mountain grasslands
  - species rich grasslands[1]
  - linked to summer farming[1]
  - developed through centuries[2]
- Motivation:
  - 30 % of the Norwegian red listed species depend on semi-natural grasslands[3]
  - strong decline in summer farming – the grasslands are endangered[1]
  - need special management – GRAZING[1]

- [1]Norderhaug & Ihlse (2003)
- [2]Bryn et al (2001)
- [3]Directorate for nature management (1994)

STUDY SITES

	Valdres	Skåbu
Meters above sea level	1000	935
Number of recorded species	73	103
Dominating species	More common	Common & base demanding
Bed rocks	Less base & nutritritious rich	Base & nutritritious rich
Distribution of vegetation types	Dryer and less uniformed	More humid and uniformed
Maped areas	18 km^2	8 km^2
Herd density in the area	Three other herds	None

THE STUDIED HERDS ON THE SUMMER FARMS

	Valdres	**Skåbu**
Herd size	11 (5 STN, 4 NRF)	14 (6 STN, 3 NRF)
Mean age	5.6 years old	4.5 years old
Months since last calving	5.5 months	5.5 months
Mean walking distance per day	7.3 km	8.0 km
Milk production per year	STN: 4 500 kg, NRF: 5 800 kg	

RECORDING PROCEDURES GRAZING BEHAVIOUR (Paper II)

- Recording frequencies
  - Every 10 minutes, eight hours/day.
  - One week early summer
  - One week late summer
  - Three summers

TESTED TRAITS

- **Traits**
  - playing
  - lying
  - standing
  - walking
  - ruminating
  - drinking
  - grazing

GRAZING PRACTICE

- The cows were grazing all day, no fencing, indoor during night time

RESULTS ALL TRAITS

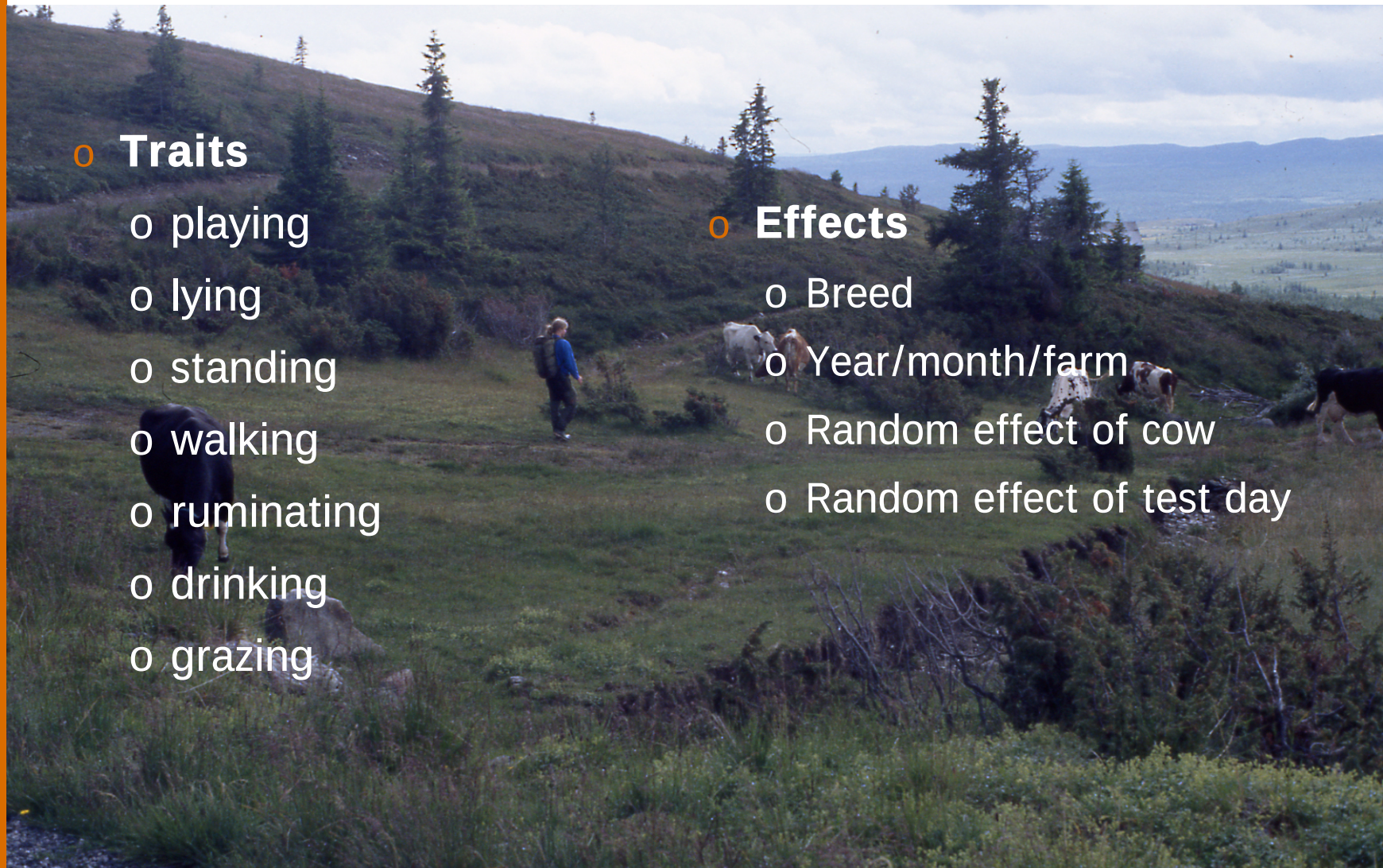
General activity	Time spent
Playing	1.8 %
Lying	5.4 %
Standing	57.8 %
Walking	35.5 %

Eating activity	Time spent
Ruminating	9.3 %
Grazing	87.6 %
Drinking	3.1 %

- 45 % of the time during 24 h cows are lying (Løvendahl & Munksgaard, 2004)
- 50 % of day time cows are grazing (Albright & Arave, 1997)

→ High activity level

TESTED TRAITS



- **Traits**
  - playing
  - lying
  - standing
  - walking
  - ruminating
  - drinking
  - grazing
- **Effects**
  - Breed
  - Year/month/farm
  - Random effect of cow
  - Random effect of test day

RESULTS GRAZING ACTIVITIES

Trait	N	Breed	Year/ month/ farm	Random effect of cow	Random effect of test day	Breed difference
playing	200	**	-	-	**	STN plays more
lying	348	-	**	**	**	-
standing	348	**	**	**	**	NRF stands more
walking	348	*	**	**	**	NRF walks more
ruminating	521	-	**	**	**	-
drinking	521	-	**	-	**	-
grazing	521	-	**	**	**	-

**1%, * 5%, - = not significant

RESULTS GRAZING ACTIVITIES

Trait	N	Breed	Year/ month/ farm	Random effect of cow	Random effect of test day	Breed difference
playing	200	**	-	-	**	STN plays more
lying	348	-	**	**	**	-
standing	348	**	**	**	**	NRF stands more
walking	348	*	**	**	**	STN walks more
ruminating	521	-	**	**	**	-
drinking	521	-	**	-	**	-
grazing	521	-	**	**	**	-

**1%, * 5%, - = not significant

BREED DIFFERENCES IN GRAZING BEHAVIOUR

- NRF stands more
- STN plays and walks more

- The resource allocation theory (Beilharz, 1993)

  ”animals with high production capacity have lower activity level than animals with low yielding capacity”

DIFFERENT GRAZING PREFERENCES? (Paper III)

RECORDING PROCEDURES GRAZING PREFERENCES (Paper II)

- 49 faeces samples from individual marked cows

	STN	NRF
Skåbu	14	14
Valdres	10	11

- Analyzed for plant fragments by a micro histological method (Garcia-Gonzales, 1984)

- 29 plant and plant groups recorded
  - 15 tested for breed differences

- Vegetation maps over grazed areas (18 km^2 & 8 km^2)

- GPS on the bell cow

RESULTS GRAZING PREFERENCES

[1]**Total grass** = *Deschampsia cespitosa, Deschampsia flexuosa, Festuca rubra* ssp. *Rubra, Festuca ovina, Festuca* spp, *Poa* spp, *Moli cer, Agrostis* spp, *Anthoxanthum odoratum, Phleum alpinum, Nardus stricta, Melica nutans, Alop gen, Graminae.*

[2]**Total *Festuca*** = *Festuca rubra* ssp. *Rubra, Festuca ovina, Festuca* spp

** 1 %, * 5 %,

- = not significant

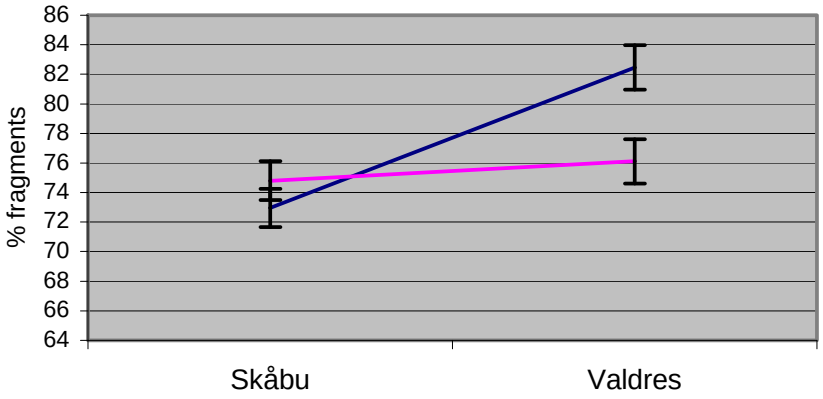
Species	Mean value %	Breed	Month	Farm	Farm x breed	Percentage of found fragments	
						STN	NRF
Blueberry (blåbær) *Vacc myr*	0.99	-	-	**	**	1.84	2.09
Heather *Call vul*	2.13	-	-	**	-	1.93	2.06
Tufted hair grass *Desch ces* (sølvbunke)	25.54	-	-	**	-	26.99	25.13
Wavy hair-grass *Desch flex* (smyle)	15.08	-	**	**	-	15.00	14.94
Meadow grass *Poa* spp.	3.46	-	**	*	-	3.80	2.95
Bent grass *(Agro* spp.)	2.55	-	**	*	-	2.76	2.70
Matgrass (finnskjegg) *Nardus stricta*	3.82	*	-	**	*	5.08	3.76
Sedge species (starr) *Carex* spp.	8.36	-	-	**	*	8.39	9.47
Herbs	8.37	-	-	**	-	7.66	7.53
[1]Total grass	76.13	-	-	**	**	77.68	75.80
[2]Total *Festuca*	10.83	-	-	**	-	9.17	10.66

CONCLUSION

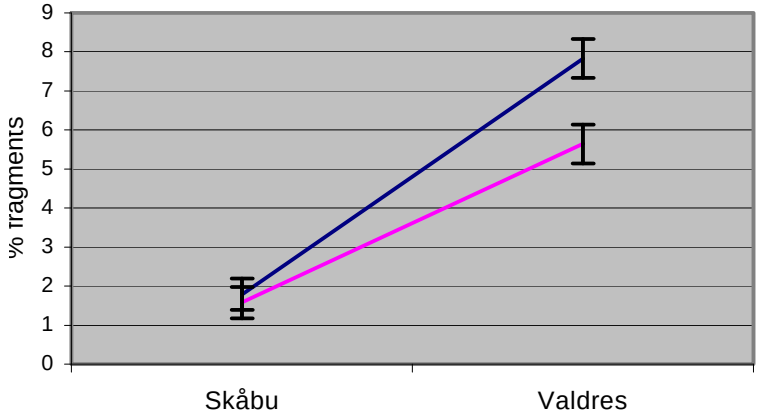
- The cows mainly grazed grass species.
- Significant breed difference for *Nardus stricta* (Mat grass)
- Significant differences between the two summer farms for all plants and plant groups.
- No significant breed differences for any plant when farms tested separately, but some indications in Valdres (poorer bed rock)
- Genotype by environment interaction for four traits, strengthening the indications found in Valdres.

BREED DIFFERENCES IN GRAZING PREFERENCES?

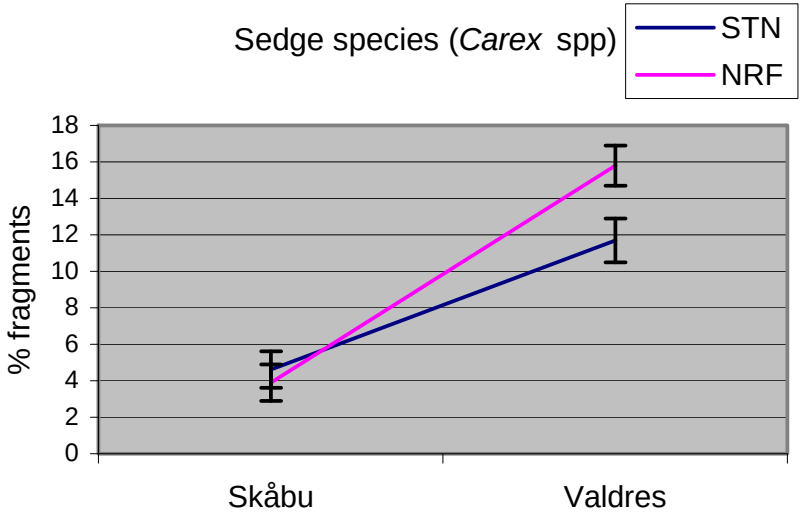
Grass species



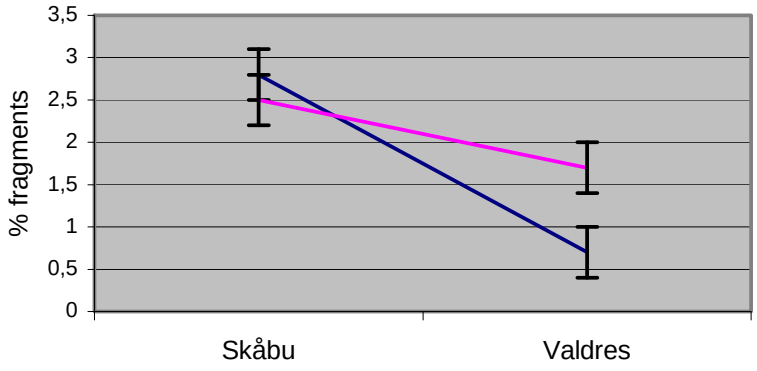
Matgrass (*Nardus stricta*)



Sedge species (*Carex* spp)



Blueberry (*Vaccinium myrtillis*)



BREED DIFFERENCES IN GRAZING PREFERENCES

- Species and nutritious rich grasslands:
  - No breed differences
- Less species and nutritious rich grasslands:
  - Tendency:
    - The high yielding breed selects nutritious rich plants and vegetation types
- The resource allocation theory (Beilharz, 1993)
  - “animals seek nutrients according to their production level”

CONCLUSION

- From the questionnaire:
  - The farmers were concerned about conserving an alternative dairy breed.
  - The farmers expected the STN cows to milk less than NRF, and still give the same net income.
  - The farmers expected the STN cows to be better on extensive pastures than NRF.

CONCLUSION

- From the production study:
  - Significant breed differences:
    - milk yield
    - live weight
    - gross energy efficiency:
  - No significant breed differences
    - Energy balance
    - Energy efficiency

CONCLUSION

- From the grazing studies
  - The STN had higher activity than NRF
  - NRF seemed to select more of the nutritious rich plants and vegetation types than STN when grazing less species and nutritious rich grasslands

FINAL CONCLUSION

The breeds have different selection history –

- NRF - documented genetic change for
  - Milk yield
  - fertility
  - mastitis

- STN no information on genetic change for any traits

FINAL CONCLUSION

The study gives new information about what effect selection for higher production has on traits relevant for extensive and marginal production systems.

The lack of breed difference in energy efficiency rises question on the assumption that breeding for higher yield gives more efficient animals.

The indicated differences in grazing preferences on extensive pastures is a confirmation on these native and endangered breeds' potential importance for the management of endangered semi-natural grasslands.

THANK YOU FOR YOUR ATTENTION!