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The development of population structure and inbreeding parameters in dairy cattle breeds kept for conservation and grazing purposes.



A. Rehnberg and N.H. Sæther  
Norwegian Genetic Resource Centre  
EAAP 2011  
Stavanger, August 29



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# Outline

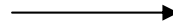
- > Native and endangered cattle breeds in Norwegian landscape
- > Population development of five native and endangered cattle breeds in Norway
- > A case study;
  - > Differences between Western Fjord cattle and Western Red Polled in population structure and development
  - > Possible explanations to the differences



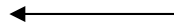
Døla (DC)



Telemark (TC)



Sided Trønder  
and Nordland  
(STN)



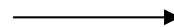
Western Red  
Polled (WRP)



Eastern Red  
Polled (ERP)



Western Fjord  
(WF)





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# Native and endangered cattle breeds and their value to the environment

- > Frequently used for grazing outlying land
  - > Landscape management
  - > Summer forage harvesting by utilizing the outlying land
  - > 75 % of the farms with endangered cattle breeds utilize outlying land (national mean = 50 %)





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# Native and endangered cattle breeds and their value to the environment

- > Frequently used for grazing outlying land
  - > Landscape management
  - > Farms base some of their forage harvesting on the resources in the outlying land
- > Easy movement in steep and rough terrain
  - > Local and endangered breeds are often smaller and lighter than for example Norwegian Red (NRF) or beef cattle breeds
    - > Mountains and mountainous plateaus cover 44.4% of the land area of Norway.
- > Grazing differences between breeds (Sæther et al. 2006)



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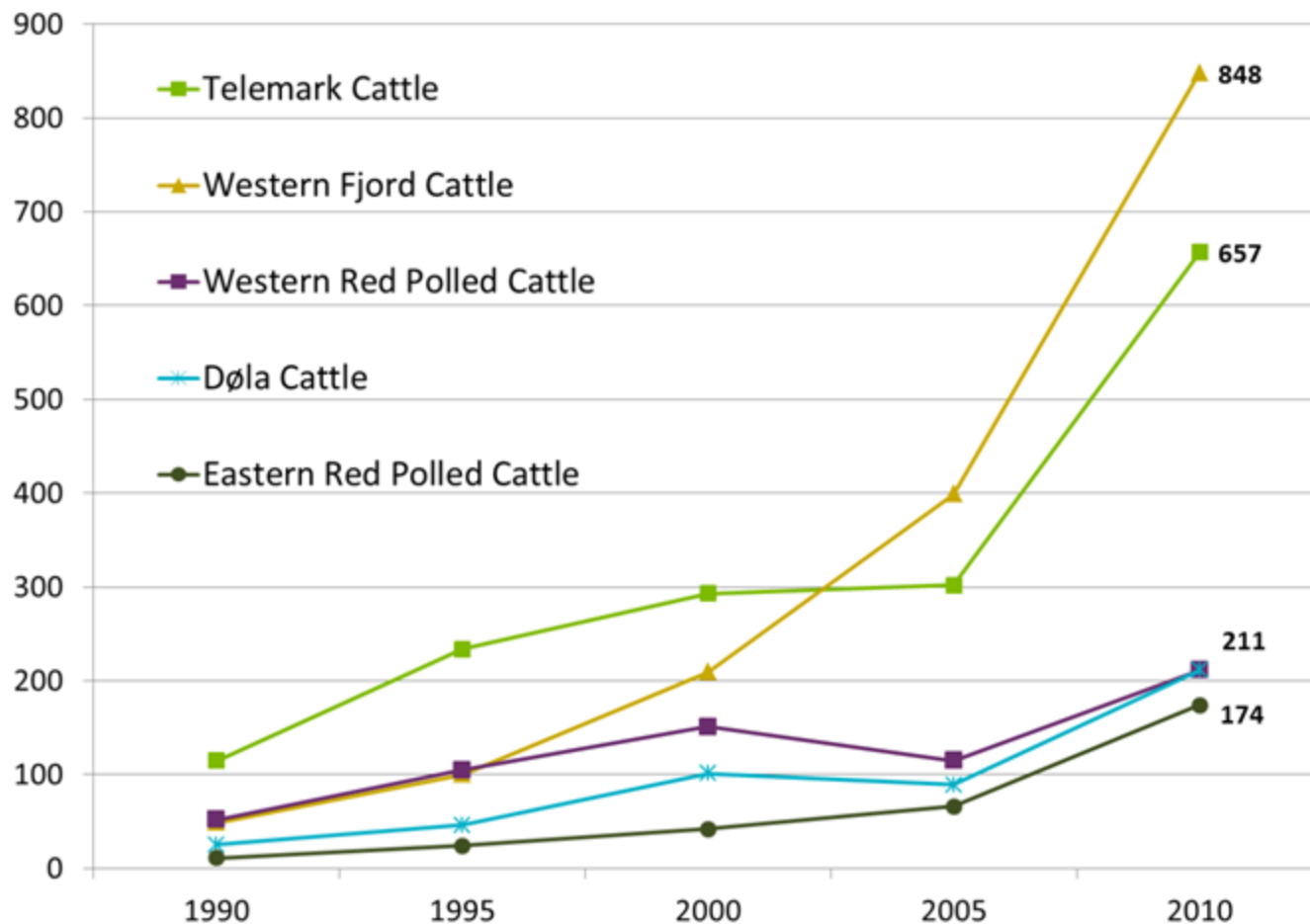
# Development of the populations of the native and endangered cattle breeds

> Conservation programs started in 1989





# Number of breeding females



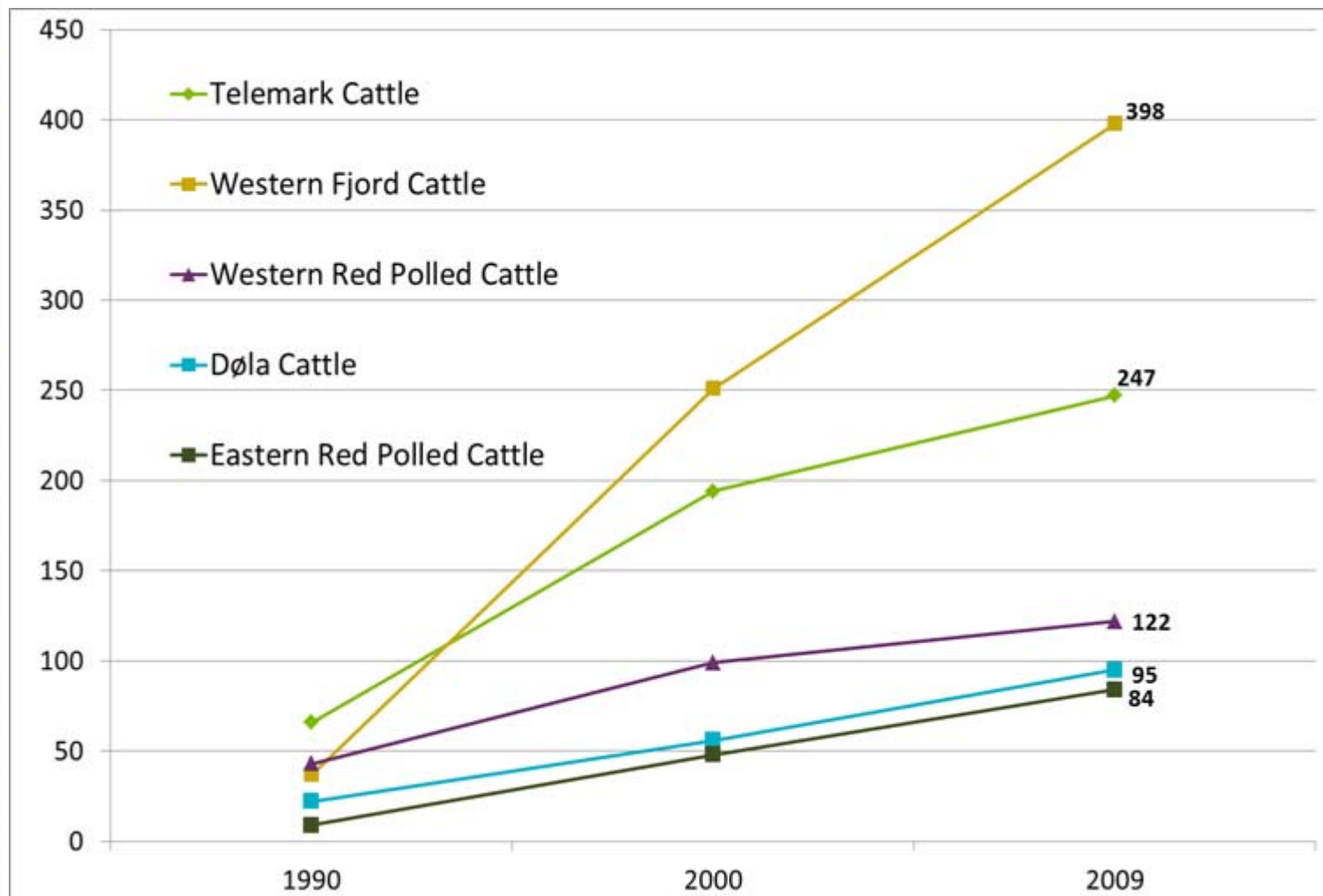




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# Number of born calves





# Estimating effective population size ( $N_e$ )

- >
- >  $N_e$  based on rate of inbreeding ( $N_e = 1/2\Delta F$ )

$$\Delta F = \frac{F_t - F_{t-1}}{1 - F_{t-1}}$$

- >  $N_e$  based on the number of parents

$$N_e = \frac{4N_m N_f}{N_m + N_f}$$

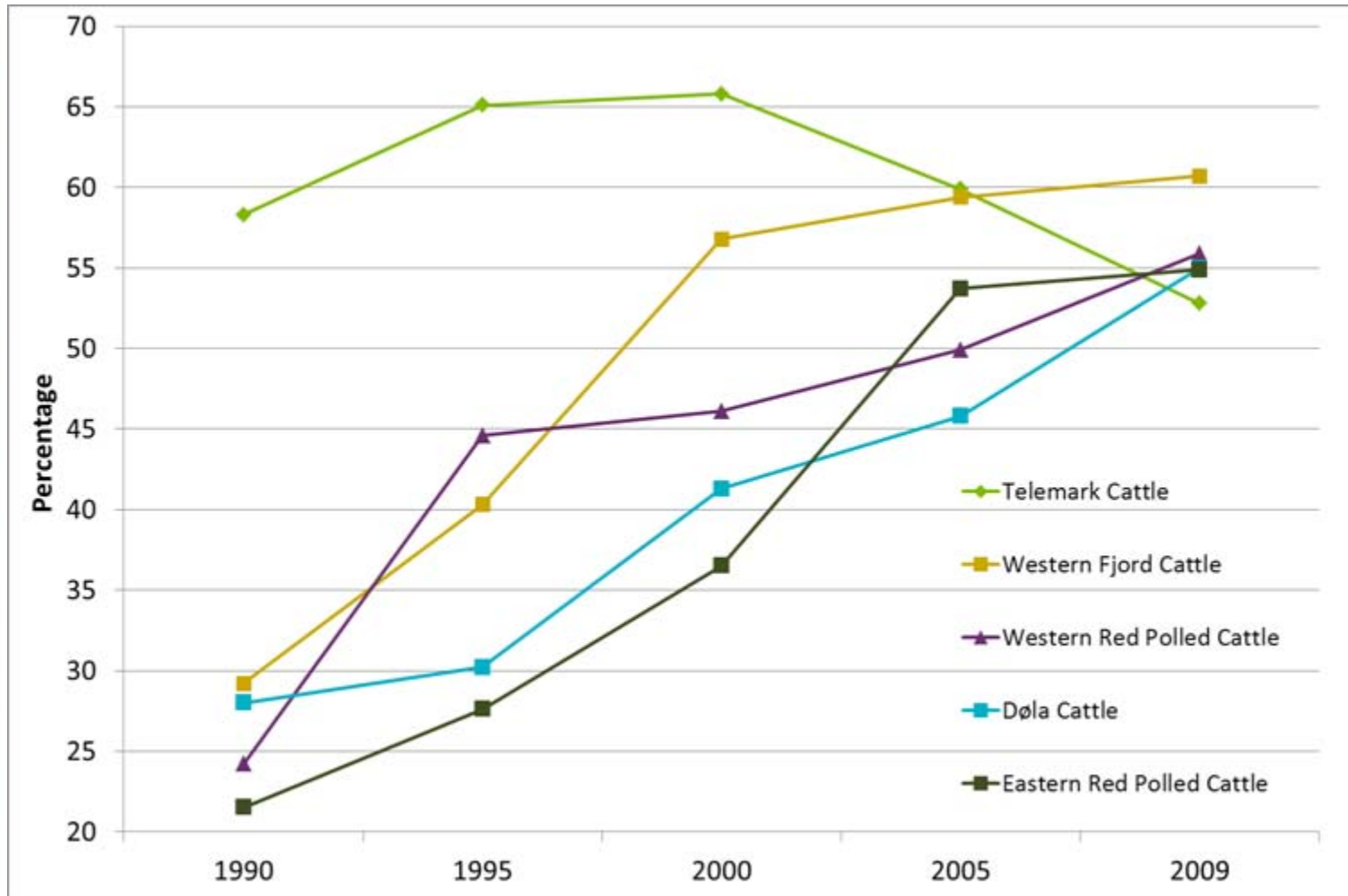
- > PopReport, Institute of Farm Animal Genetic, Mariensee, Germany
- > <http://popreport.tzv.fal.de>

# Average pedigree completeness for six generations



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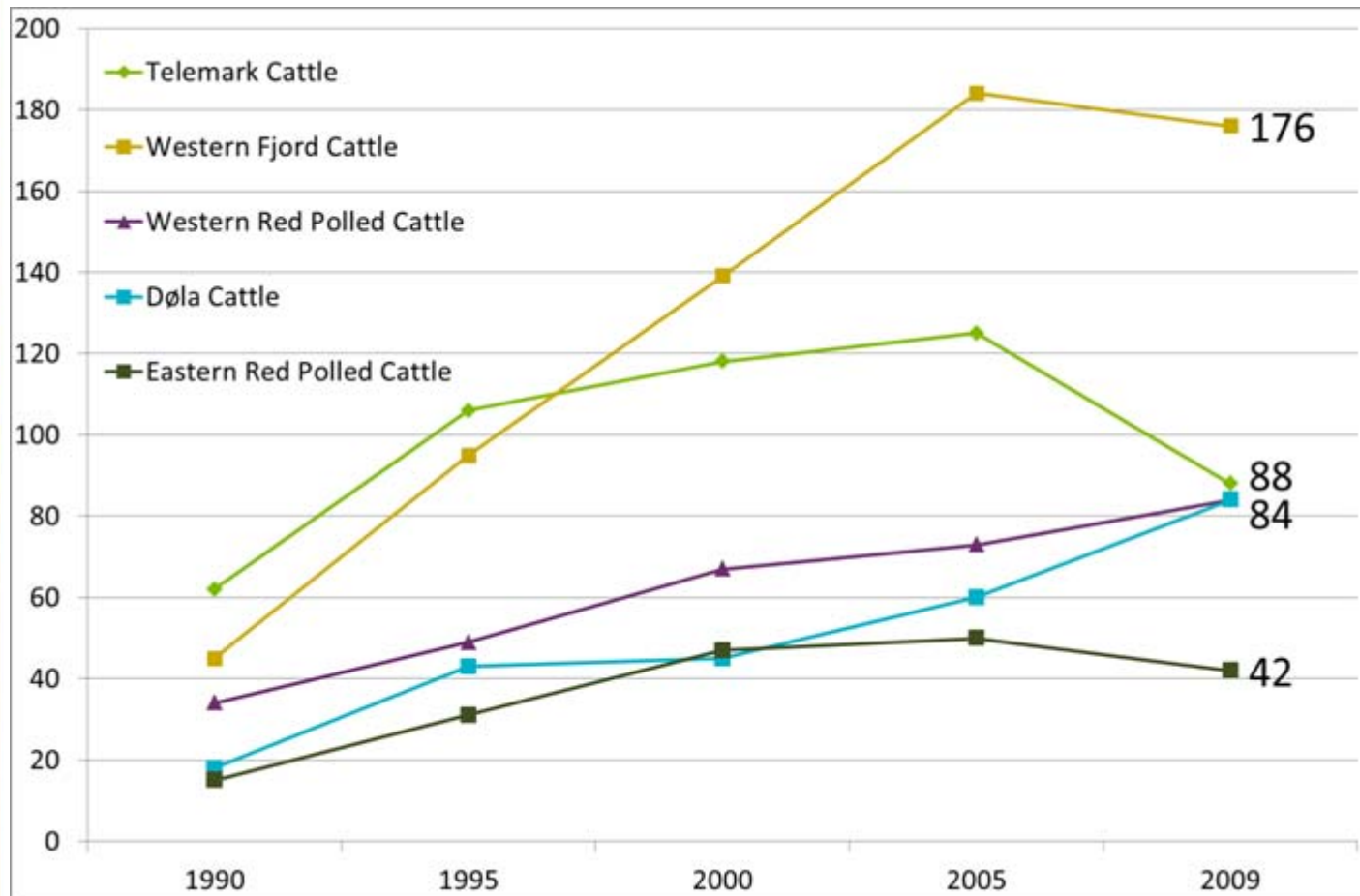
# Effective population size based on $\Delta F$

	Telemark Cattle		Western Fjord Cattle		Western Red Polled Cattle	
	$\Delta F$	Ne	$\Delta F$	Ne	$\Delta F$	Ne
1990	0,0087	57	0,0053	94	0,0011	455
1995	0,0019	263	0,0067	75	0,0331	15
2000	-0,0106	-	0,0148	34	-0,0072	-
2005	-0,01	-	-0,0011	-	-0,0023	-
2009	-0,0082	-	0,0005	1000	0,001	500

	Døla Cattle		Eastern Red Polled Cattle	
	$\Delta F$	Ne	$\Delta F$	Ne
1990	0,015	33	0,0006	833
1995	0,0168	30	-0,006	-
2000	0,0015	333	0,0172	29
2005	-0,0011	-	0,0031	161
2009	0,0064	78	0,0062	81

$$\Delta F = \frac{F_t - F_{t-1}}{1 - F_{t-1}}$$

# Effective population size based on the number of parents



$$N_e = \frac{4N_m N_f}{N_m + N_f}$$



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- > Native and endangered cattle breeds in Norwegian landscape
- > Population development of five native and endangered cattle breeds in Norway
- > A case study;
  - > **Differences between Western Fjord cattle and Western Red Polled in population structure and development**
  - > Possible explanations to the differences



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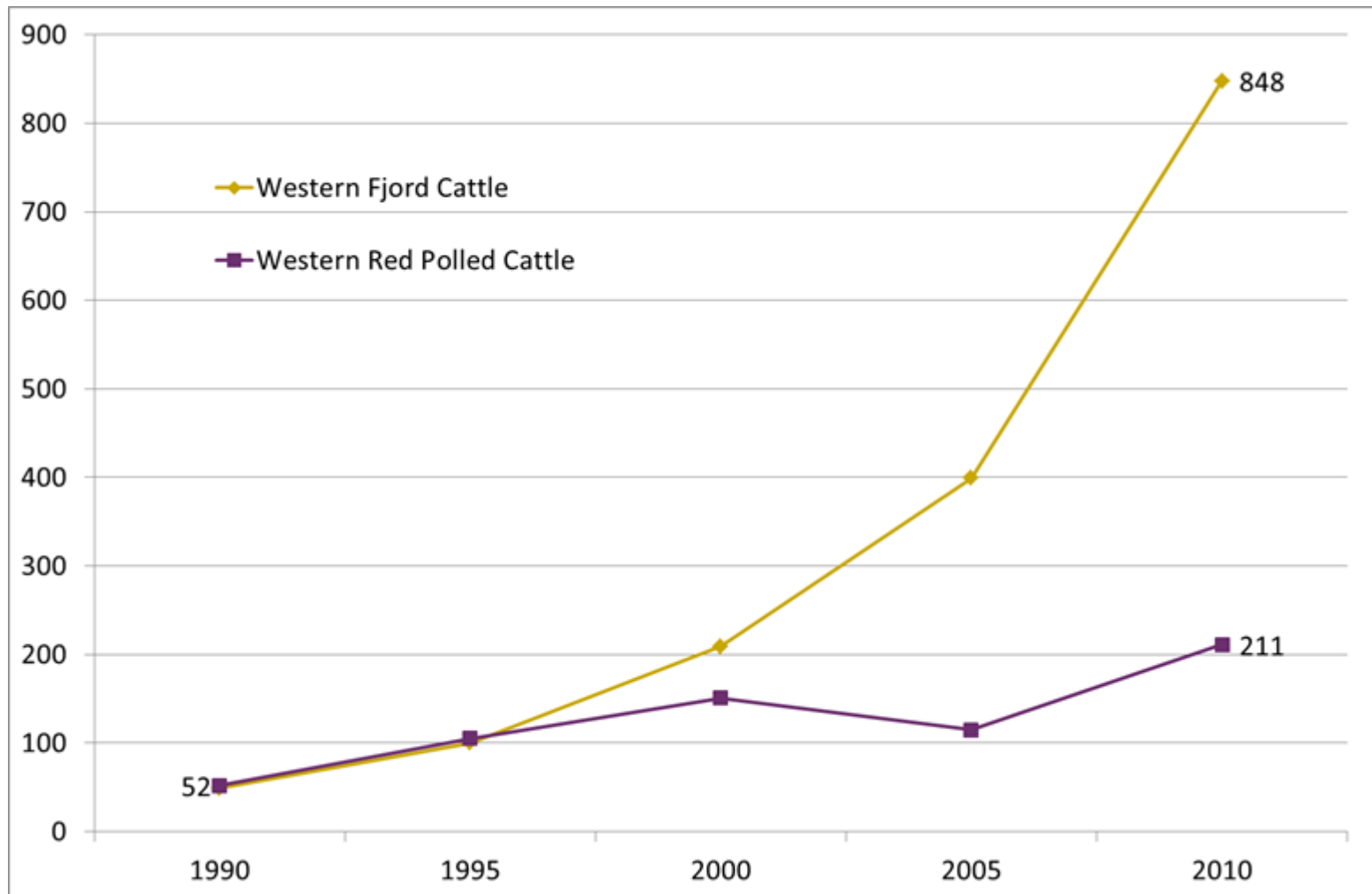
# Western Fjord vs. Western Red Polled

- > Two endangered Norwegian cattle breeds
  - > Populations where recorded for conservation in 1989
  - > Started of with approximately the same population structure
    - > 50 breeding females (>2 year and pure bred)
    - > 20 breeding bulls on farm
    - > 10 AI bulls
    - > 20 herds
  - > More or less the same size
    - > Withers height 120/121 cm
    - > Breast size 170/172 cm





# Number of breeding females



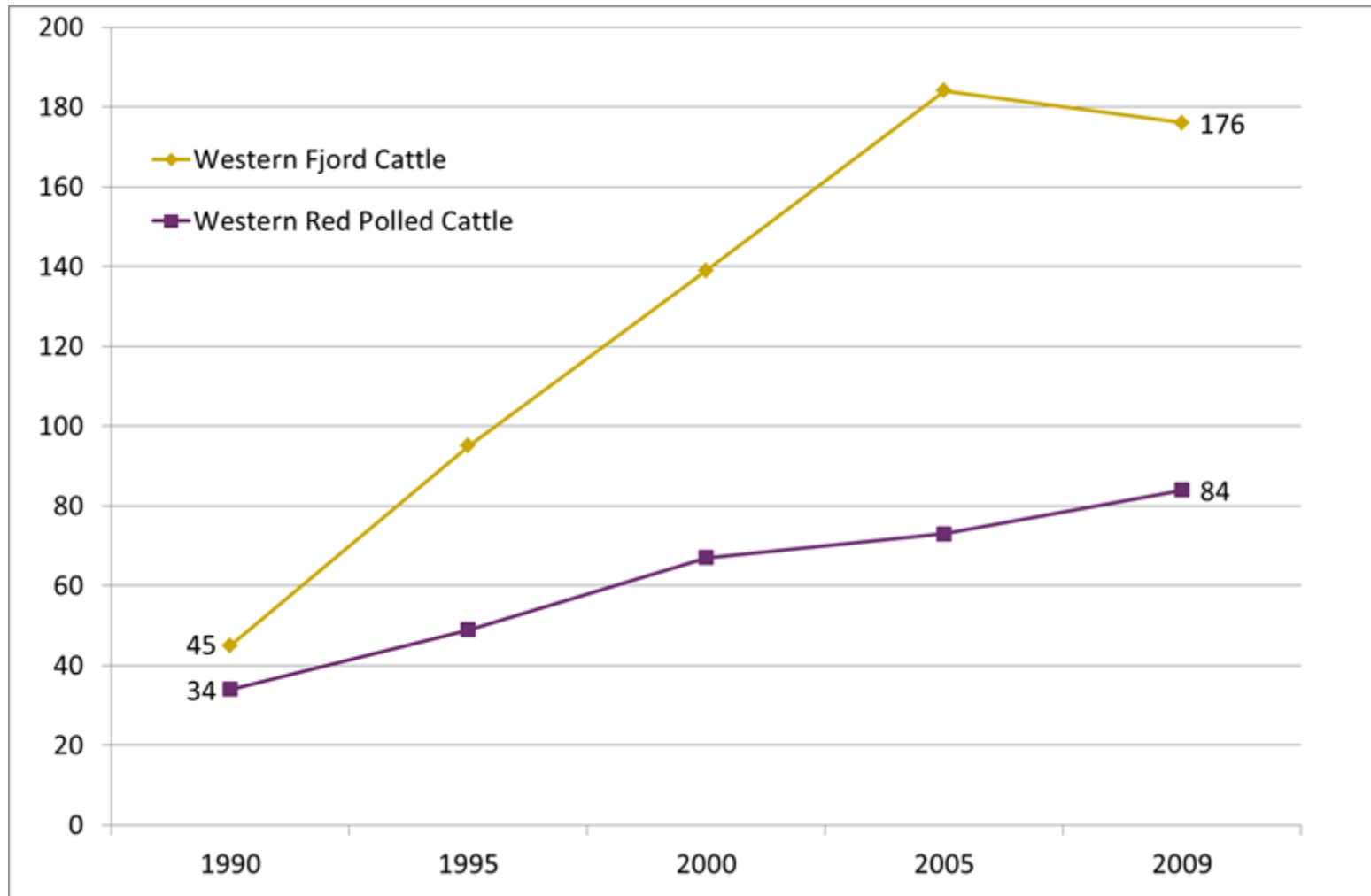


# Western Fjord vs. Western Red Polled Population Structure – use of sires

## AI bulls vs. on farm bulls

	Western Fjord	Western Red Polled
AI bull	43,4 %	61,7 %
On farm bull	43,3 %	21,4 %
No. of AI bulls (2011)	50	48
Unknown sire	13 %	16,8 %

# Effective population size based on the number of parents





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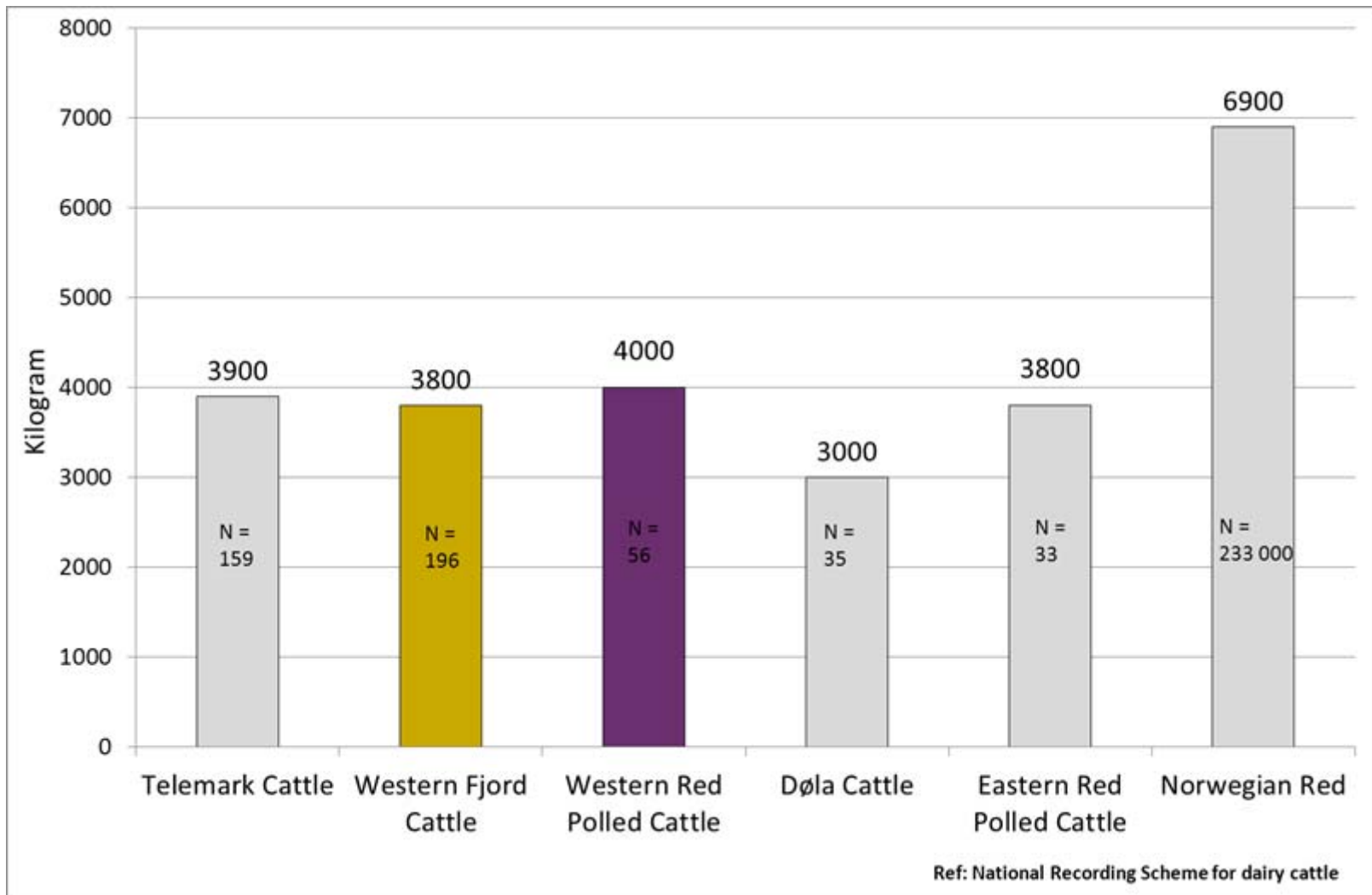
- > Native and endangered cattle breeds in Norwegian landscape
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# Differences in milk yield





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# Differences in phenotype and owners

- > Fjord cattle:
  - > Nicer colours?
  - > Better organized owners?

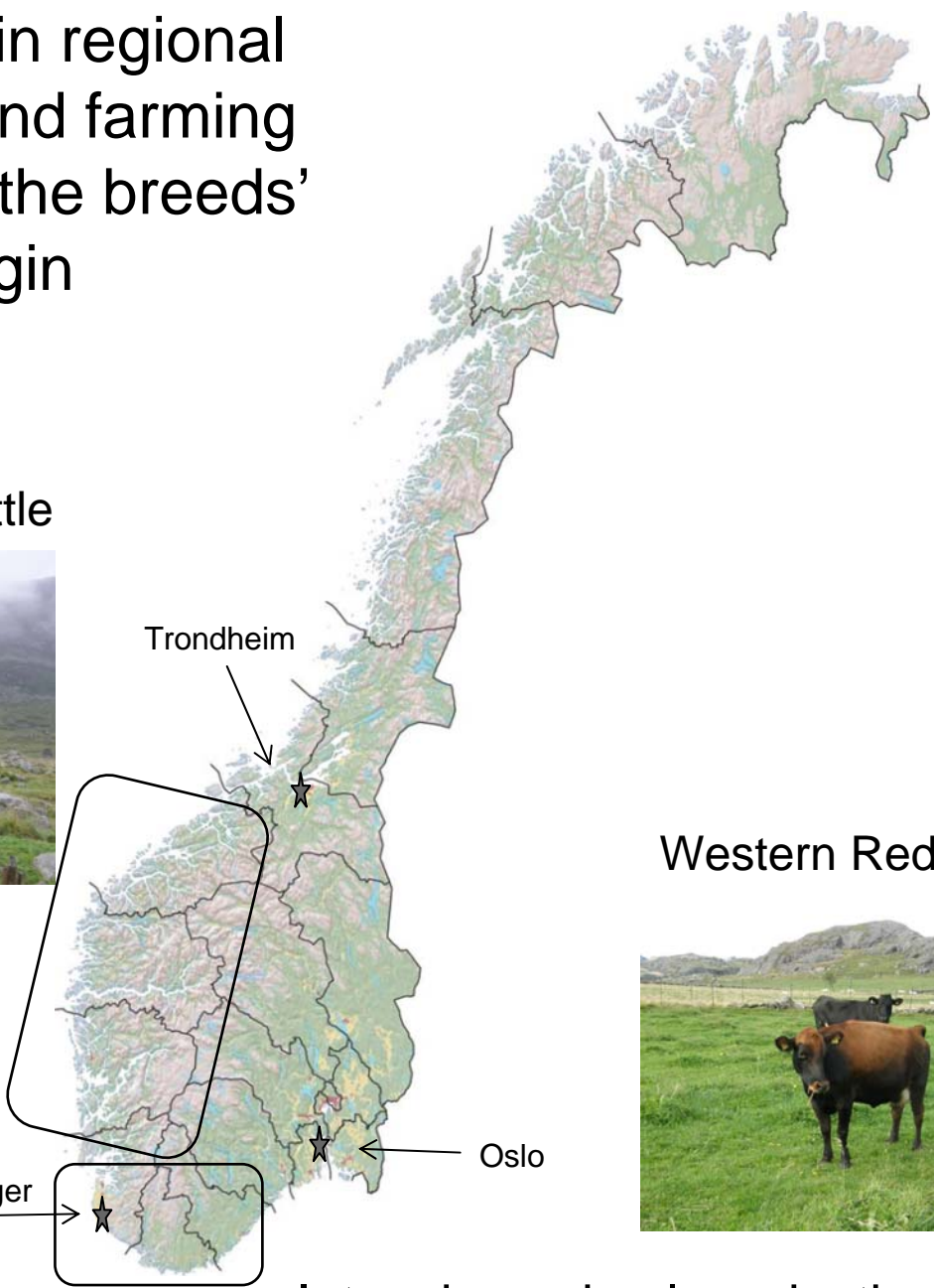


# Differences in regional landscape and farming traditions in the breeds' center of origin

## Western Fjord Cattle



Extensive  
small farms



## Western Red Polled



Intensive animal production



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# Summary

- > Native and endangered cattle breeds frequently graze outlying land
- > Their population structure has developed in different ways
- > Possible explanations for these differences have been discussed
  - > Milk yield
  - > Phenotype
  - > Owners
  - > Landscape and tradition

Thank you for your attention

