



# Sheep Breeding in Norway

## Sheep Breeders Round Table 2015

---

Thor Blichfeldt Ron Lewis

Director of Breeding Professor,

University of Nebraska-Lincoln

The **N**orwegian Association of  
**S**heep and **G**oat Breeders (**NSG**)

# Outline

---

- ❑ Sheep production in Norway
- ❑ Breeds
- ❑ Sheep recording
- ❑ NSG – the sheep breeding company
- ❑ Traits, EBVs and total merit index
- ❑ Genetic gain
- ❑ R&D
- ❑ Genomics
- ❑ Key points about sheep breeding in Norway

# Sheep production in Norway (1)

- Production per year
  - 24 million kg of meat
  - 4 million kg of wool
- Consumption
  - 5 kg per capita per year
  - Self sufficient
  - Some import
    - Tax protection

- Sheep farmer economy
  - Heavily subsidised
    - 2/3 of the income
    - Per animal
    - Per hectare
  - Good farmer prices
    - 4-5 £ per kg carcass weight
    - 3 £ per kg of wool
  - Norwegian costs
    - high (oil related)
  - Net income from sheep
    - Low, but improving

# Sheep production in Norway (2)

## □ Structure

- Farmers: 12 000
- Ewes (1+ years): 700 000
- Small flocks:
  - Average 55 ewes
  - Few 300+ ewes

## □ Production very seasonal

- Indoor lambing April-May
- Slaughter in August-November
  - Age 160 days
  - Carcass weight 20 kg

## □ Housed during winter

- Before mating until 1-2 weeks after lambing

## □ Intensive care during lambing time

- Assist the ewe
- Assist the lamb
  - Colostrum
- One lost lamb is one too many

# Sheep production in Norway (3)

## - Feeding

**Norway: 3% arable land**

- ❑ Grass silage in the winter
- ❑ Spring pasture on farm
  - 2 - 6 weeks  
Aprile – May – June
- ❑ Summer pasture in the woods or the mountains (mid June - mid Sept.)



**Photo:  
Grethe Ringdal**



**Photo:  
Grethe Ringdal**



Photo:  
Grethe Ringdal



**Photo:  
Grethe Ringdal**

# Sheep production in Norway (3)

## - Feeding

---

- ❑ Grass silage in the winter
- ❑ Spring pasture on farm
  - 2 - 6 weeks  
    Aprile – May – June
- ❑ Summer pasture in the woods or the mountains (mid June - mid Sept.)

- ❑ Autumn pasture on farm
  - First group of lambs:  
    Directly to the abattoir –  
    September
  - Second group: October
  - Third group: November
  - The rest: Jan. - Feb.

- ❑ Concentrate
  - Ewes
  - Lambs

# Breeds

---

- Norwegian Spælsau – 3 lines: 15 %
  - Most important: Flock instinct
  - Short tail (“spæl”)
  - Fleece: Dual coated wool, white - coloured
  - Polled - Horned
- Norwegian White Sheep (NWS): 75 %
  - Long tail
  - Fleece: Crossbred type, white
  - Polled
- 10-15 other breeds: 10 %

# Norwegian Spælsau of today

---



# Norwegian White Sheep - definitely a composite

**NWS:**  
A population,  
not a proper breed



# NWS:

## - Sire line or maternal line?

---

- 90,000 ewes in 950 breeding flocks (2014)
  - Number of lambs born: 2.29
  - Age of slaughter, days; 156
  - Carcass weight, kg; 21.1
  - Carcass conformation: R+ (9.3)
  
- NWS is a dual purpose breed
  
- Used as "pure"
  - No appreciable crossbreeding in Norway

# Animalia:

## The Norwegian Sheep Recording System

### □ Sheep Recording in Norway

- Sheep producers: 30%
- Ewes: 43%
- Slaughtered lambs: 49%

### □ Central database

- On farm data
  - Web / Mobile app
- Abattoir data
  - File transfer

### □ Output

- Management tool
- Benchmarking
- EBVs
- R&D

# Recording (2)

- Individually recorded
  - Electronic ear tags (EID)
- Birth info
  - Dam and Sire
  - Total born
  - Live born
  - Lambing ease (code)
- Weights of lambs
  - Birth
  - 6 weeks
  - 20 weeks (weaning)
- Disease
  - Mastitis

- Abattoir info
  - Carcass weight
  - EUROP conformation and fat score
  - Fleece weight and quality
- NOT DONE IN NORWAY
  - Ultrasound scanning for meat and fat
  - CT scanning
  - Fecal egg count

# The breeding company:

## - *NSG* and the Ram Circles (1)

### **NSG:**

- **The breeding plan**
- **EBVs**
- **AI**

- 80% of sheep farmers are members of NSG (10,000)
- NSG Breeding Council
  - 5 breeders
  - 2 from the abattoirs
  - 1 from the Agr. University
- Central office at Ås
- Breeding and AI is half of the activities in NSG
  - Director: Thor B.
  - 3 geneticists
  - 3 breeding consultants

- NSG budget for breeding: 1.3 mill. £
  - Gov. support: 45%
  - Levy on meat: 15%
  - AI sales: 40%
- Responsible for the breeding programme
- Calculating EBVs
  - 13 runs per year
- AI
- R&D

# The breeding company:

## - NSG and *the Ram Circles* (2)

### The Ram circle:

- **Select rams**
- **Circulate rams**
- **Plan elite matings**

- Ram circle: A small financially independent organization that has breeders as members
  - More than 50 years of good work
- Rams are owned by the ram circle and used among member flocks
- Ewes are owned by the members themselves
- Cooperating with NSG
  - Regulations
  - **Guidelines**
  - **Financial support from NSG**
    - 150 £ per test ram that qualifies

## AI: The key to success

- Selection intensity of rams
- Connectedness among flocks

# NWS breeding

- The breeding population
  - 150 ram circles
  - 950 members
  - 90,000 ewes
- Progeny testing of rams
  - Selection within ram circle
    - Test rams (0.5 y.): 1,800
    - Elite rams (1.5 y.): 300
- AI
  - Selection across ram circles
    - 20 rams (2.5 years)
    - 5 rams (3.5 years)

- Elite matings
  - 15% of ewes in ram circles are AI'd
- Sired by an AI ram in ram circle flocks (2014)
  - Lambs born: 9%
  - Lambs slaughtered: 5%
  - Ewes lambing: 21%
- AI sires in ram selection
  - Test rams sired by an AI ram: 85%

# AI the Norwegian way

## - 35.000 semen doses per year

---

**"A shot in the dark"**

- ❑ No synchronisation, no hormone treatment
- ❑ Oestrus detection 2-3 times per day
  - Walk the ram; Leach and apron
- ❑ Inseminate once 18-24 hours after onset of oestrus
  - Frozen semen – 240 mill. sperm cells
  - Vaginal deposition
  - Done by the farmer
- ❑ Non-return: 70%
- ❑ Cost: (Rent of shipper + freight + 20 doses)
  - Per semen dose: 23 £

# Traits in the breeding work - heritabilities and weighting

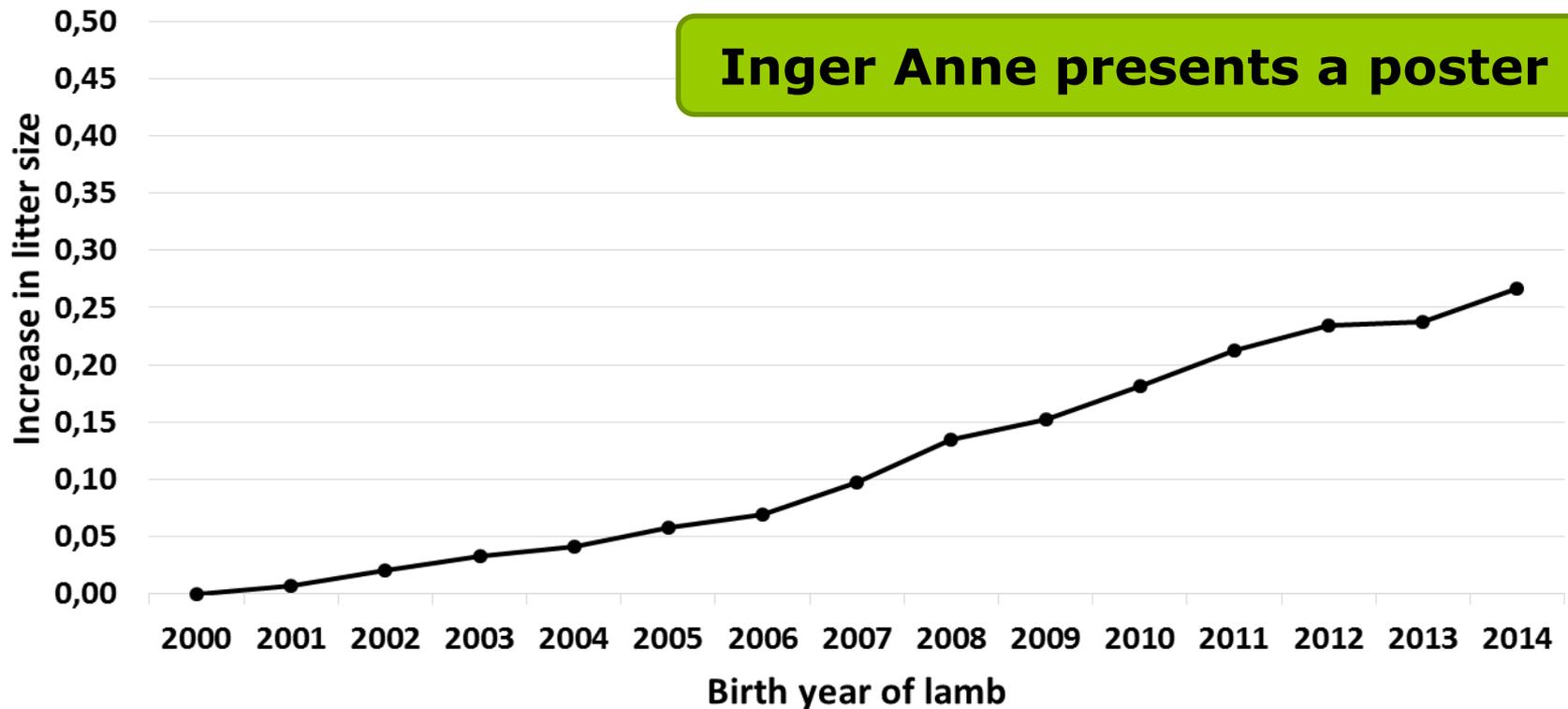
**Selection on  
total merit index**

<b>NKS</b>	<b>Heritability <math>h^2</math></b>	<b>Weight in the total merit index</b>
<b>Lamb traits</b>		
Growth, carcass weight at 22 w.	0.12	24 %
EUROP conformation score, at 20 kg	0.19	18 %
EUROP fat score, at 20 kg	0.19	11 %
Fleece weight, at 20 kg	0.33	2 %
Fleece grade, at 20 kg	0.08	0 %
<b>Ewe traits</b>		
Maternal ability, at 6 weeks	0.06	15 %
Maternal ability, at 22 weeks	0.05	24 %
Litter size, total born	0.13	6 %

# The name of the game (1): Genetic gain – litter size

**Enough  
is enough!**

Number of lambs born

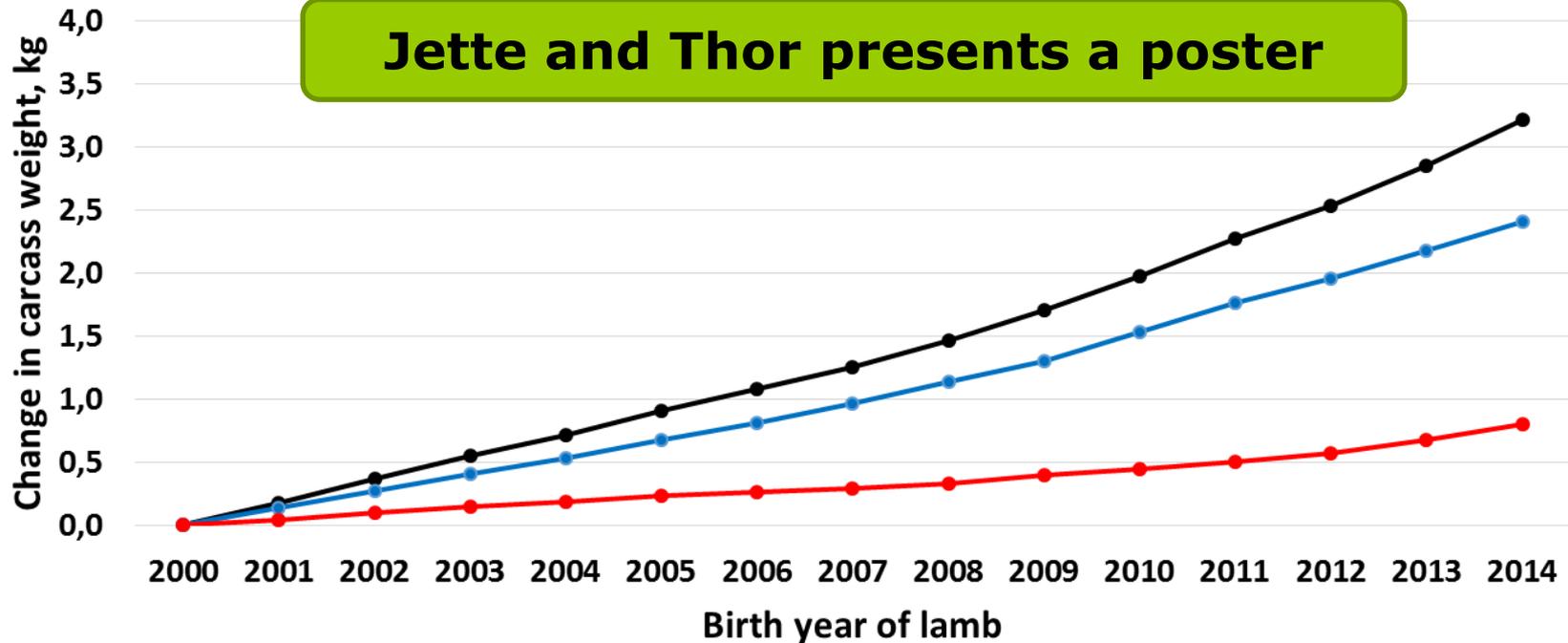


# The name of the game (2): Genetic gain – lamb growth

**Goal:  
Slaughtered  
straight from the  
mountains**

Lamb carcass weight at 22 weeks

—●— Total genetic gain    —●— Direct    —●— Maternal



## The breeders: Have to do more recording!

- New traits?
  - ~~Early lamb loss~~
  - Lambing ease (new scoring)
  - ~~Lamb vigour~~
  - ~~Suckling assistance~~
  - Udder and teat conformation
  - Mastitis
  - Longevity
- Improved models
  - Adjusting weights for age
  - Adjusting EUROP scoring for age or weight
  - Heterogeneous variances
  - Litter size:  
Reduce variability
  - Contemporary groups within flock-year
- Genomic information

# Genomic selection

---

## □ The key equation

$$\Delta BV_X / t = \frac{r_{BV_X, P_X^*}(i_X) \sigma_{BV_X}}{L}$$

## □ Genomic tools may allow

- Increased accuracy ( $\uparrow r_{BV_X, P_X^*}$ )
  - Via “Genome-enhanced” EBV
- Decreased generation interval ( $\downarrow L$ )

# Opportunities

---

- Facilitate improvement of otherwise difficult-to-measure traits ( $r_{BV_X, P_X^*}; L$ )
  - Traits expressed later in an animal's life
    - Longevity
  - Traits expressed in only one sex
    - Fertility, litter size
  - Traits that are expensive and/or challenging to measure
    - Lamb survival, mastitis, maternal bonding, eating quality

# Opportunities

---

- ❑ Facilitate improvement of otherwise difficult-to-measure traits ( $r_{BV_X, P_X^*}; L$ )
- ❑ Form a better pedigree ( $r_{BV_X, P_X^*}$ )



# Challenges

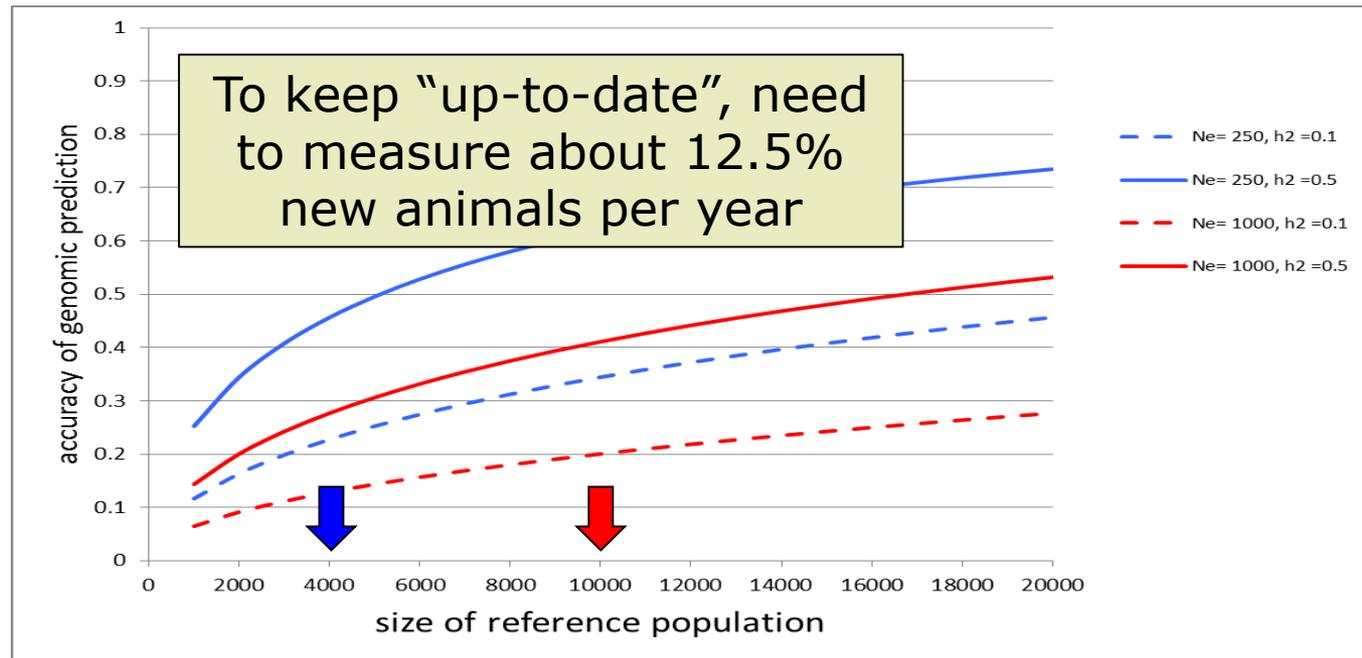
---

- Requirement is likely for large reference populations in individual breeds
  - “Large” to capture genetic diversity within a breed
  - “Within breeds” because genomic predictions do not extend well across breeds
    - In many industries, there are lots of breeds
  - Validation (training) must be ongoing
    - Accuracies deteriorate as ancestors used to form genomic predictions become more distant

Structure of ram circles likely well suited to form industry-based reference populations

# Challenges

- Requirement is likely for large reference populations in individual breeds



(Goddard, 2009; Hayes et al., 2009; van der Werf et al., 2011)

# Challenges

---

- ❑ Requirement is likely for large reference populations in individual breeds
- ❑ Costs of genotyping
  - Value per animal unit is relatively low in sheep
  - However, the per animal cost of genotyping is nearly the same across species

# Benefits vs. costs

---

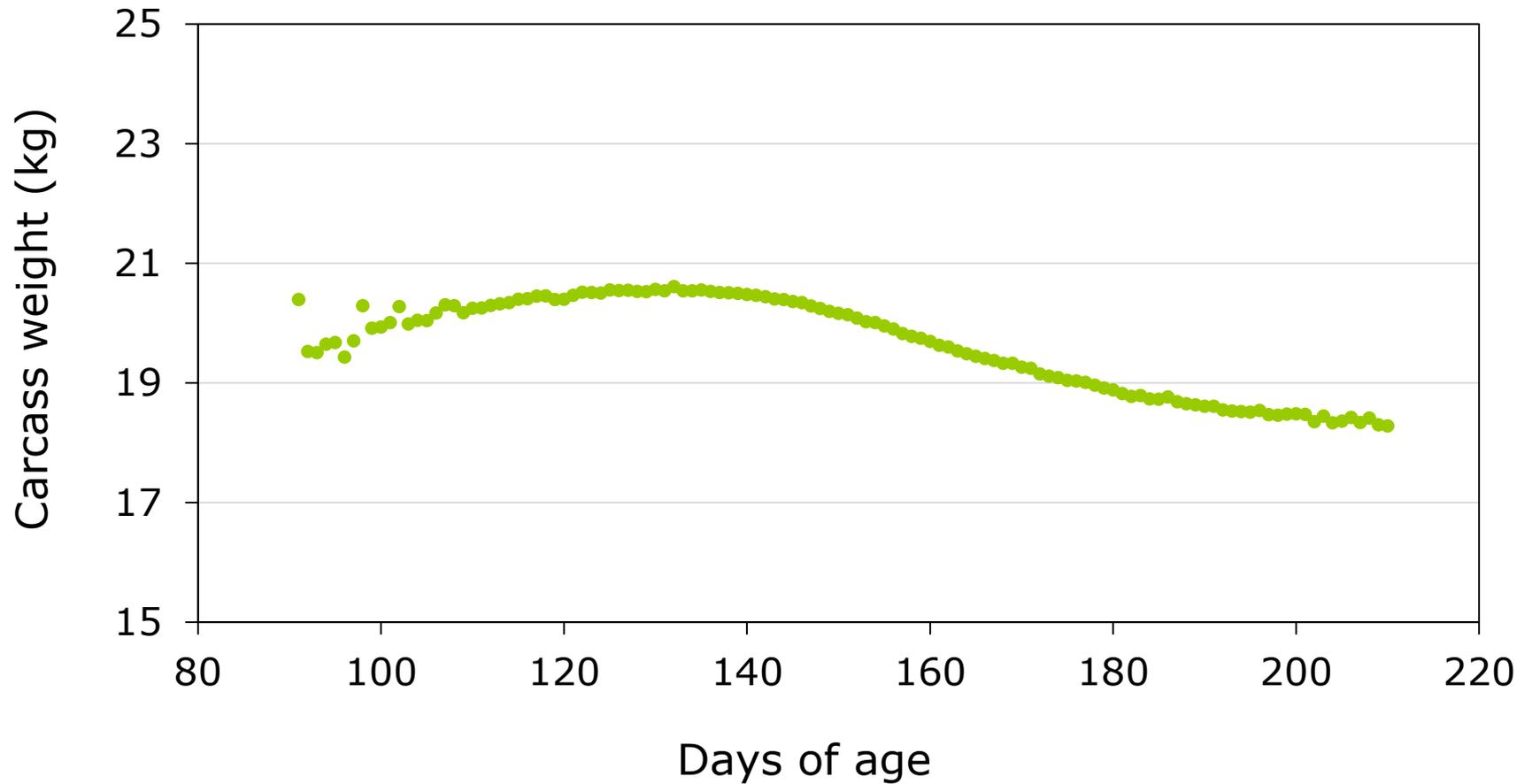
- The utility of genomic selection in the Norwegian industry will depend on
  - Gain in accuracy realized
    - Function of the number (diversity) of performance recorded sheep, e.g., 1/4 million Norwegian White ewes
  - Economic importance of traits being considered
  - Cost and thereby industry uptake of genotyping

# Norwegian lamb finishing system

---

- ❑ Lambs grazed over-summer on mountain or forest pasture
- ❑ Once gathered, drafted on-farm
  - Over-weight & over-finished lambs marketed immediately
  - Target weight & finished lambs also marketed immediately
  - Under weight and/or under-finished lambs retained
    - ❑ Grass and/or concentrate fed until achieve a target end-point or end-of-season

# Carcass weight by age (2014)



# Norwegian lamb finishing system

---

- ❑ What then is the target end-point for adjustment for genetic evaluation?
  - Weight (20-25 kg)?
  - Age (20 weeks)?
  - Finish?
  - A combination of several?
- ❑ Given varying drafting strategies, how should contemporary groups be defined?
  - Will (and should) producers provide more delineating contemporary group designations?

# Sheep breeding

**Making results – together!**

## - what is unique for Norway?

- Centrally financed
    - 1.3 million £
  - Recording
    - One central database
    - Carcass data transfer
  - Large breeding population
    - 90,000 ewes
    - 1,800 rams
  - AI
    - The very best rams
    - Intensively used
  - Substantial genetic and phenotypic gain
- The sheep breeders
    - A strong belief in the breeding theory
    - Confidence in the central breeding management
    - The same breeding goal for all breeders within a breed
    - Collaboration, not competition
      - Within ram circle
      - Across ram circles

# Invitation to World Championship in Ewe Productivity

Norwegian contestant – Hove 2010-00003

Year	Lambs	20 week weight
2011	2	60 + 61
2012	4	62 + 67 + 64 + 61
2013	3	63 + 66 + 72
2014	3	61 + 59 + 60
2015	2	62 + 57
<b>Sum</b>	<b>14</b>	<b>875 kg</b> <b>175 kg per year</b>

## Progeny for breeding:

- 6 daughters
- 2 AI rams



**Concentrate** given to the ewe, not the lambs:

- **56 kg per year**