Selection of Norwegian White Sheep rams for AI on EBV and ram circle connectedness

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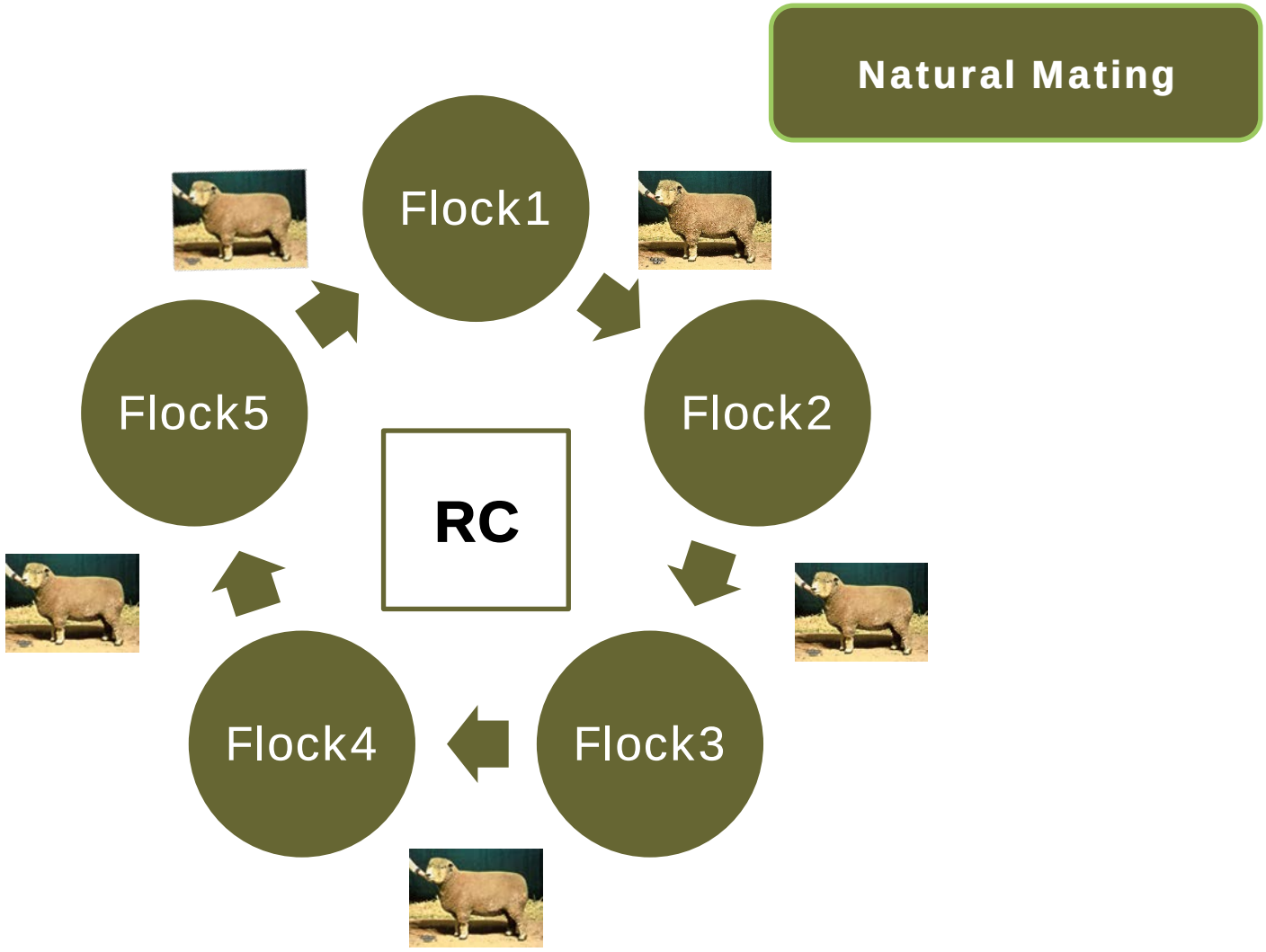
Why worry about connectedness?

- **Want unbiased comparison of EBVs** of animals from different breeding units
- **Disconnected flocks:** Risk of poor separation of environment and genetics

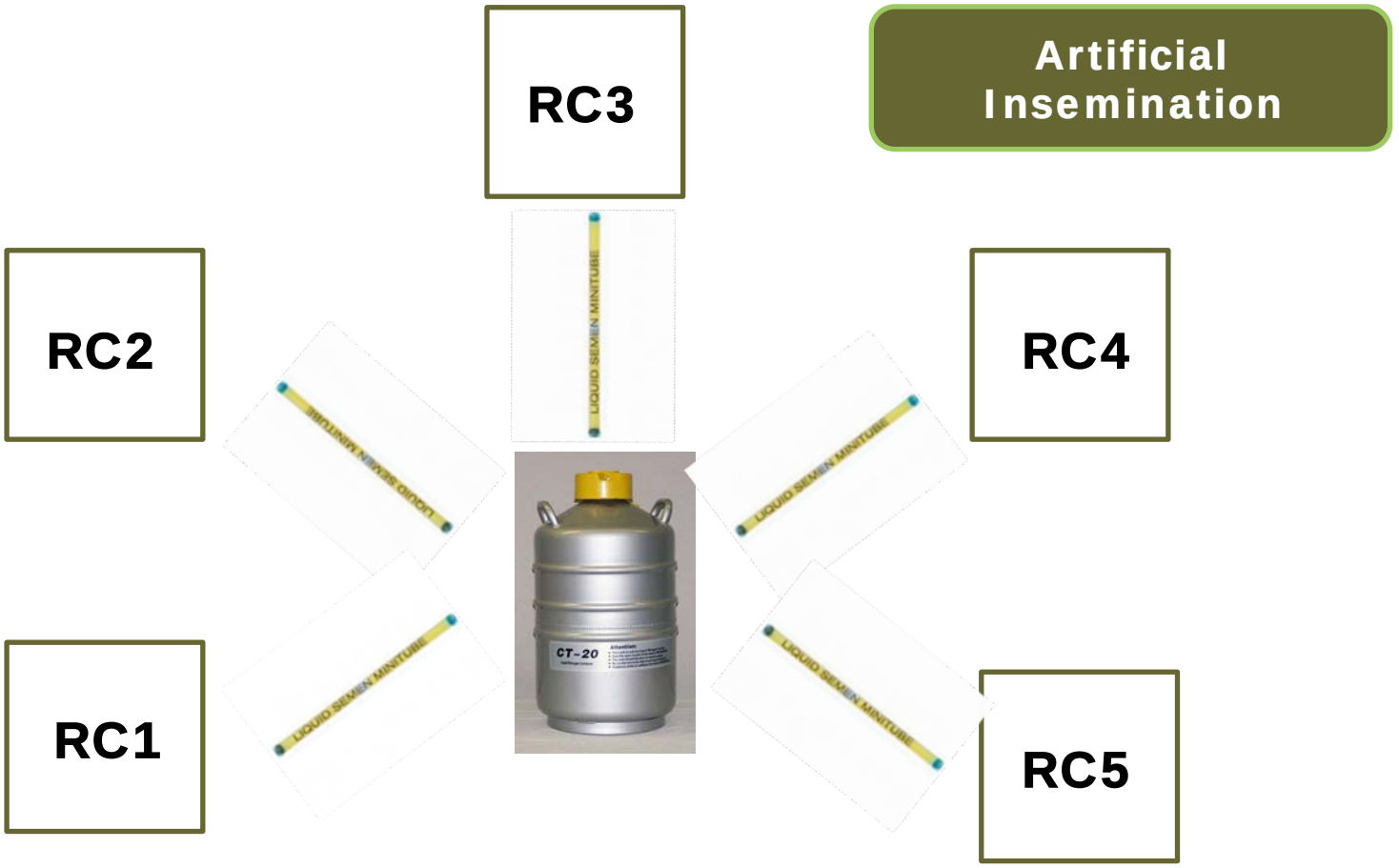
Aim of study

- Investigate **strength of connectedness** within and across ram circles in Norwegian White Sheep
- Investigate if **strength of connectedness** has changed over time
- Use **strenght of connectedness** as an indication of **risk of selection bias** at different stages of ram selection

Connectedness within ram circle



Connectedness across ram circles



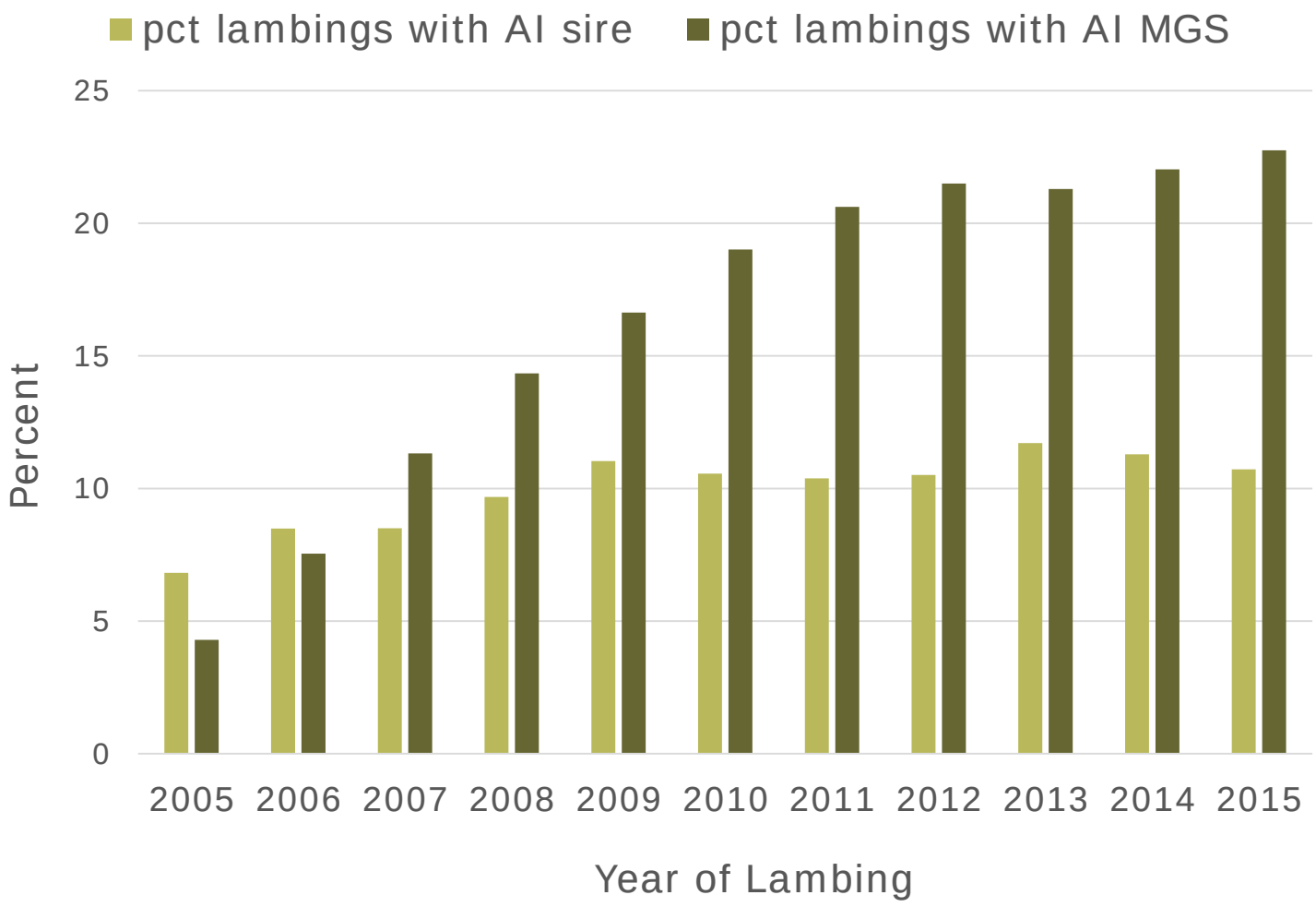
Selection of rams

Selection based on total merit index and relationship among animals

- Test rams (0.5 year)
  - **Selected within** the **ram circle** among the 0.5 year old phenotypically tested test ram candidates
- Elite rams (1.5 year)
  - **Selected within** the **ram circle** among the previous year's test rams
- AI rams (2.5 year)
  - **Selected** by The Norwegian Association of Sheep and Goat Breeders **across ram** circles among the previous year's elite rams

Trend in AI usage

Large increase in lambings with AI MGS



Data from Norwegian Sheep Recording

- **2.4 million weaning weight records**
  - NWS lambs born in 1996 to 2015
- **2.5 million pedigree records**
  - 55 300 different sires
  - Av. number of progeny per sire: 44.2 (1 – 3439)
  - 47 253 different maternal grand sires (MGS)
  - Av. number of daughters per MGS: 9.7 (1 – 1422)
- **132 ram circles**
  - Av. number of flocks per ram circle: 7.3 (1 - 24)
- **966 flocks**
  - Av. number of lambing per flock in 2015: 91.4 (9 – 523)

Model

- **Animal Model**
- **Fixed effects**
  - Flock-year (1,…, 17 176)
  - Interaction of litter size at tagging, litter size at weaning, age of rearing dam, sex (1,….,114)
- **Random effect**
  - Animal

Flock connectedness measure

Connectedness software by Lewis *et al.* (2005)

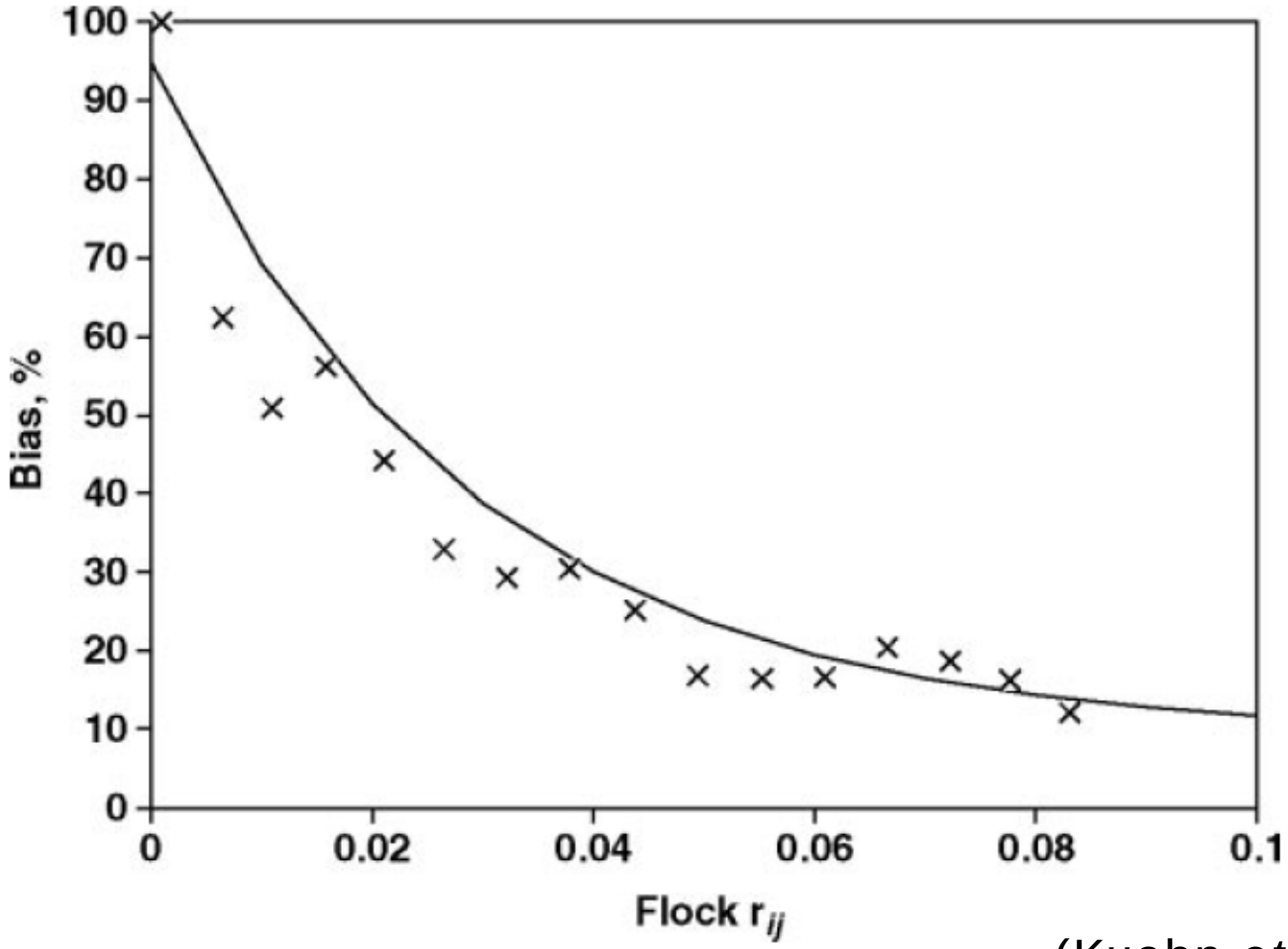
Flock connectedness computed as:

$$r_{ij} = \frac{\mathrm{PEC}(\hat{\bar{u}}_{i.}, \hat{\bar{u}}_{j.})}{\sqrt{\mathrm{PEV}(\hat{\bar{u}}_{i.})\mathrm{PEV}(\hat{\bar{u}}_{j.})}}$$

where $\hat{\bar{u}}_{i.(j.)}$ is the mean breeding value of all animals recorded in flock $i(j)$ since recording began

Connectedness and bias

0.00:	Cannot be compared
0.05:	Moderate links
0.10:	Strong links
1.00:	One flock



(Kuehn *et al.*, 2014)

Connectedness among flocks within ram circle

Year	Min	Max	Avr
2005	0.002	0.594	0.266
2010	0.027	0.630	0.283
2015	0.050	0.676	0.318

Connectedness among ram circles

Year	Min	Max	Avr
2005	0.002	0.048	0.021
2010	0.003	0.054	0.026
2015	0.011	0.063	0.034

Conclusion & Reflexion

- **Increase in connectedness over time**
  - Caused by increase in AI?
- **Moderate to strong connectedness among flocks within ram circle**
  - Limited bias in selection of test and elite rams
- **Weaker connectedness among ram circles**
  - More uncertainty when comparing EBVs among AI ram candidates
  - Maybe a strategy of **considering EBV <u>and</u> ram circle** connectedness when selecting rams for AI ?
  - **Encourage use of AI** to improve genetic links ?


Questions ?
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