

# Performance, welfare, health and hygiene of laying hens in cage and non-cage systems

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# Outline

- Comparison of performance, welfare health and hygiene of birds:
  - Within non-cage systems - barn versus free range and organic systems
  - Between non-cage and cage systems
- Adaptations for the future
  - Housing and husbandry
  - Animal breeding



# Non-cage systems

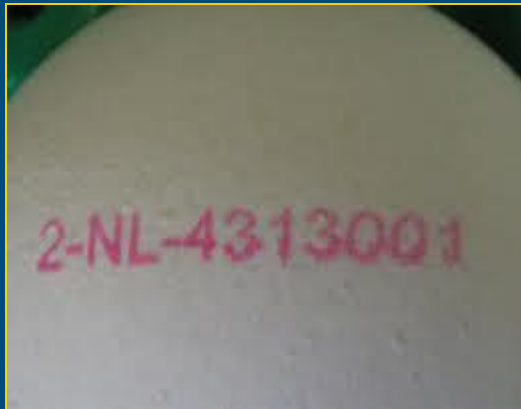
## Barn system



## Free range



## Organic



# Main differences

	Barn	Free range	Organic
Space per bird	1,111 cm <sup>2</sup>	1,111 cm <sup>2</sup>	1,667 cm <sup>2</sup>
Outdoor space	No	4 m <sup>2</sup>	4 m <sup>2</sup>
Outdoor access	No	8 hours/day	8 hours/day
Group size	Unlimited	Unlimited	Max. 3,000
Beak trimming	Yes	Yes	No

# Winter garden

- Used as transition from barn to outdoor run (Häne *et al.*, 2000)
- Continuously available: extra floor space
- Also used in systems without outdoor run
  - Offers daylight, fresh air, litter, roughage



# Barn, free range and organic systems

- Presence or absence of outdoor run

- Advantages outdoor run

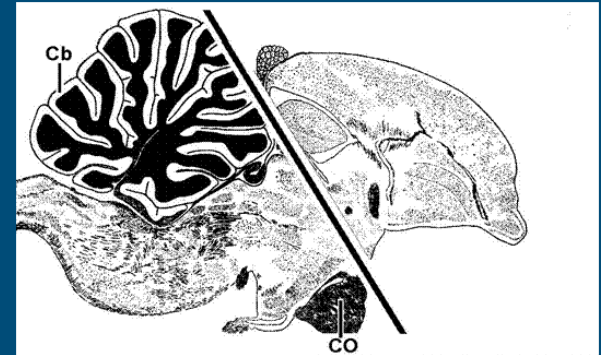
(Knierim, 2006):

- Increases space per bird
- Increases number of environmental stimuli
- Allows hens more freedom to choose between different environments



# Advantages outdoor access

- Comparison brain morphology housing systems
  - Differences in hippocampus cage + free range
  - Due to increased environmental complexity (Patzke et al., 2009)
- Positive effects on short-term learning performance (Krause et al., 2006)
- Natural light, fresh air, foraging space (Dixon, 2008)



# Advantages outdoor access

- Daylight important: absence daylight
  - Increased FP and mortality (Bestman et al., 2009)
- Comparison behaviour barn and free range (Shimmura et al., 2008):
  - Free range more foraging
  - Barn more aggression and FP
  - Fits with theory of redirected foraging (Newberry et al., 2007; Blokhuis, 1986)

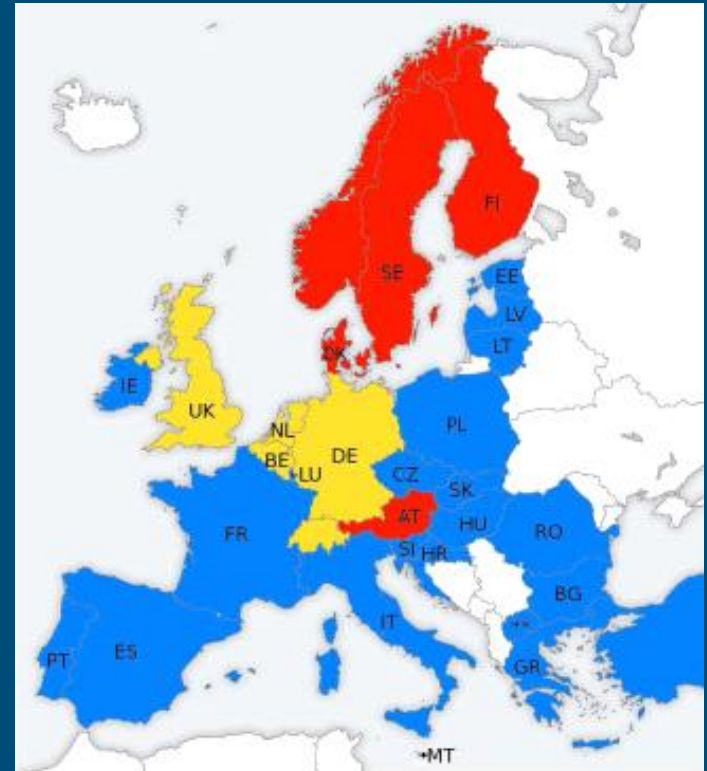


# Outdoor access and FP

## ■ Access to and proper use of outdoor run:

- Reduced risk of FP and cannibalism (Green *et al.*, 2000; Bestman and Wagenaar, 2003; Lambton *et al.*, 2010)

- ## ■ Important benefit: beak trimming prohibited in future (van Horne and Achterbosch, 2008)



# Disadvantages outdoor access

- Increased risks of predation
- Health problems (Miao *et al.*, 2005; van de Weerd *et al.*, 2009)
  - Bacterial infections, such as *Pasteurella* infections (55% mortality!) (Hegelund *et al.*, 2006)
  - Gastrointestinal helminths: risk for infection *Salmonella* / *Histomonas* (Permin *et al.*, 1999)



# Red mites

- Infestations in all poultry production systems
- More severe in free range systems (Guy *et al.*, 2004)
- Feed on the hens' blood during the night (Kilpinen *et al.*, 2005)
  - Stress
  - Anaemia
  - Increased mortality



# Health organic flocks

- Greater challenge than in free range flocks
  - Use of antibiotics and *anthelmintics* restricted
- Important to keep the parasitic and bacterial pressure to a minimum (Knierim, 2006):
  - Draw birds away from house
  - Rotating access to range
  - Using mobile housing systems



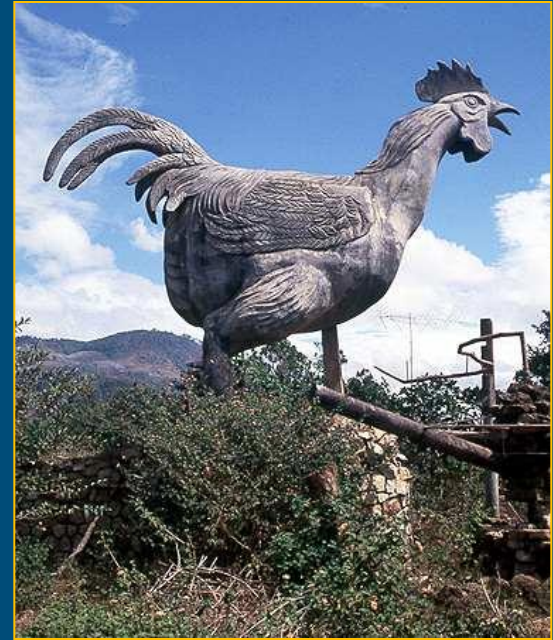
# Predation

- Risk related to free range access.
  - 6.4% 'lost' or taken by predators (Hegelund *et al.*, 2006)
- Reducing the risk of predation:
  - Improved fencing (against foxes)
  - Improved range cover (against aerial predators)
- Preference for an outdoor run that provides cover (Hegelund *et al.*, 2005; Zeltner and Hirt, 2008)
  - Providing cover increases range use



# Mortality

- **Barn systems: 8%**  
(Rodenburg et al., 2008)
- **Free range: 7%**
  - Varying between 2 and 21%  
(Whay et al., 2007)
- **Organic: 23%** (Hegelund *et al.*, 2006)
  - Some problem flocks (54 and 62%)



# Mortality



- Increased risks in organic system

- No beak trimming
- Limited use of antibiotics and anthelmintics
- Risk of piling: causes 25% of total mortality in organic flocks (Sparks et al., 2008)
- Organic diet: lack of methionine – risk of FP?  
Compensated by outdoor foraging?  
(van Krimpen et al., 2005; Acamovic et al., 2008)

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# Furnished cages

- Will also be allowed in most European countries
  - Exceptions: Switzerland (full cage ban 1992)
  - Germany and The Netherlands: colony cages only
- In furnished cages birds have (Rodenburg *et al.*, 2005):
  - More space than in conventional cages (750 cm<sup>2</sup> vs. 550 cm<sup>2</sup> per bird)
  - Access to a nest, a perch and a pecking and scratching area
  - Group size ranging from 5 to 100



# Welfare comparison FOWEL

- Cage systems scored low, barn systems intermediate, free range and organic high (de Mol et al., 2006)
- Strongest effect on welfare score:
  - Availability of feed and water (ad lib or restricted)
  - Space per hen (450 cm<sup>2</sup> to 2000 cm<sup>2</sup>)
  - Presence of perches and nests
- Free range access: small improvement in score

# Welfare – housing systems

## ■ Non-cage systems

- More active, greater use of perches and litter
- Stronger bones
- Less fearful



## ■ Furnished cages

- Lower mortality rates
- Lower incidence of keel bone fractures
- Lower dust concentrations



Rodenburg et al., 2008

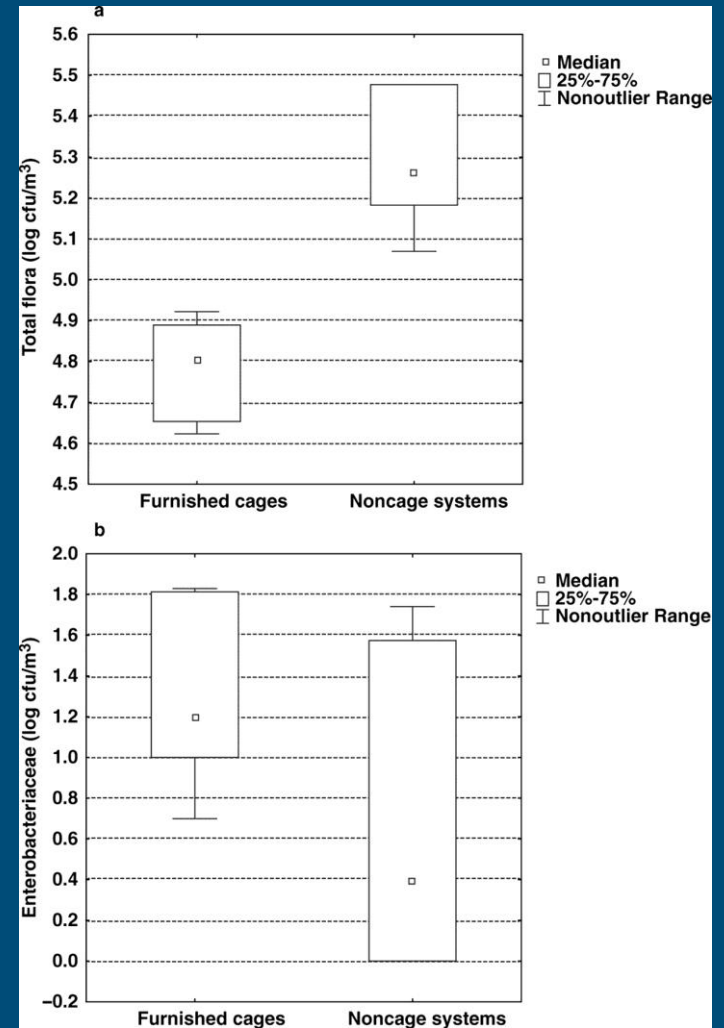
# Welfare – housing systems

- Comparison of non-cage systems with conventional cages (Shimmura et al, 2010):
  - Birds in non-cage systems: more freedom to express normal behaviour
  - Immune status similar to cage systems
  - non-cage systems lower score for freedom from pain, injury and disease
- Furnished cages were intermediate



# Hygiene / food safety

- Non-cage systems
  - Higher counts of bacteria
  - No difference in *Enterobacteriaceae* (De Reu et al., 2009)
- After cleaning + disinfection
  - No difference between systems
- Eggs shop: No difference



# Mortality

- Mortality rates in non-cage systems higher than in cage systems
  - Barn, free range > cage systems (Elson and Croxall, 2006; Fossum *et al.*, 2009)
  - 3% FC's, 8% non-cage systems (Rodenburg *et al.*, 2008)
- Systematic review mortality in conventional cages and aviary: no difference (Aerni *et al.*, 2005)
  - Risk of high mortality larger in non-cage systems



# Performance

- Feed consumption and feed conversion ratios higher in non-cage than in cage systems (Aerni et al., 2005; Elson and Croxall, 2006)
- Needs to be recovered from higher egg price for eggs from non-cage systems
  - Disadvantage for FC's: egg cannot be sold at a plus



# Egg quality

- Eggshell dirt and cracks
  - Problem in FC's
  - To a lesser extend in non cage systems  
(Mertens *et al.*, 2006; De Reu *et al.*, 2010)
- Problem can be overcome with:
  - Correct design of FC and nest box
  - Good egg collection procedures  
(Guesdon *et al.*, 2006; De Reu *et al.*, 2009)



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# Adaptations for the future

- Large differences between systems

- Within non-cage systems
- Between cage and non-cage systems



- Within non-cage systems: should we provide laying hens with outdoor access or not?

- Advantages: foraging, daylight, space, variation
- Disadvantages: health and hygiene risks, predation

# Novel approach

- Develop new housing system for laying hens
  - Based on the needs of hens, farmer and society
- Do hens really need to go outside?
  - Or can we provide key stimuli indoors?
- Two systems: Plantage and Rondeel<sup>®</sup> system



# Rondeel



# Cage vs. non-cage systems

- Behavioural opportunities are better in non-cage systems
  - Stronger bones and less fearful
- Concern: high mortality rate in non-cage systems (Rodenburg et al., 2008)
  - Reported causes: **FP and cannibalism**, health problems, infections with red mites and **smothering**



# Behaviour in large flocks

- Difficult to manage
- Improving breeding and rearing methods
- Aim: create an optimal match between the bird and its social and physical environment



# Novel genetic selection methods

- Focus on group performance rather than on individual performance (Muir, 1996; Bijma et al., 2007ab)
- Selection experiment (Ellen et al., 2007)
  - Selection for low mortality in group housing
  - 10% reduction in mortality in first generation



# Effects on behaviour

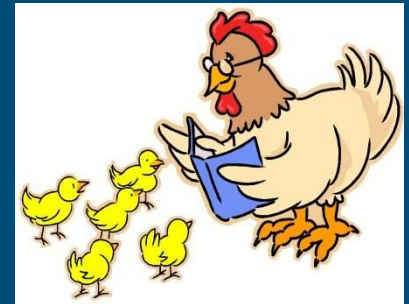
- Birds selected on low mortality:
  - Were less fearful as chicks and as adults
  - Were less sensitive to stressors
  - Showed less cannibalism  
(Bolhuis et al., 2009; Rodenburg et al., 2009ab)



- Method offers perspective to reduce FP and other behavioural problems in commercial flocks

# Improving rearing methods

- Holds great promise for improving the performance and welfare in non-cage systems
  - Match between rearing and laying environment (van de Weerd and Elson, 2006)
  - Early access to litter and perches
  - Mimic maternal care: dark brooders, stimulate foraging (Jensen *et al.*, 2006; Rodenburg *et al.*, 2009)



# Conclusions

- Large differences between housing systems
  - Performance, welfare, health and hygiene
- Moving from conventional cages to furnished cages, barn, free range and organic systems:
  - Increasing environmental complexity: positive
  - Increasing risks for performance, health and hygiene: negative



# Conclusions

- Improvements existing systems
  - Furnished cages: pecking and scratching area
  - Non-cage systems: reduce mortality
- New housing designs
  - Combine the benefits of cage and non-cage systems, such as the Rondeel<sup>®</sup> system.
- Promising approaches in animal breeding and improving rearing methods

# Thank you!

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