Early diagnostics and prevention of foot lesions in dairy cattle

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Content

Justification

Background

Maesuring lying time

Locomotion

Environmental effects affecting claw health

Genetic parameters

Future considerations

Photo: Jarmo Juga

Justification

Lameness is a painful and costly disease. It is estimated to be one of the major animal welfare issues in modern dairy production.

Lameness decreases milk production, increases involuntary culling and affects reproductive performance.

Due to its costs it is the third important healt trait after mastitis and fertility disorders.

Background

In free-stall housing cows have higher foot lesion frequency compared with traditional tie-stall barns.

The major group of foot lesions are infectious lesions.

Early detection of lesions become more and more important to manage the problem.

Photo: Jarmo Juga

The number of free-stall housing is increasing in Finland.

Percentage of Ayrshire cows with claw disorders in 2000-2010

Disorder	Cows, %	Disorder	Cows, %
Sole haemorrhages	13.96	Digital dermatitis	0.08 *
Chronic laminitis	0.61	Corkscrew claw	2.39
White line separation	3.97	Other claw disorder	0.27
Sole ulcer	0.76	*Preventive treatment = healthy*	75.22
* Interdigital dermatitis	0.32	*One or more claw disorders*	24.78
* Heel horn erosion	2.41		

105,300 observations from 52,792 cows

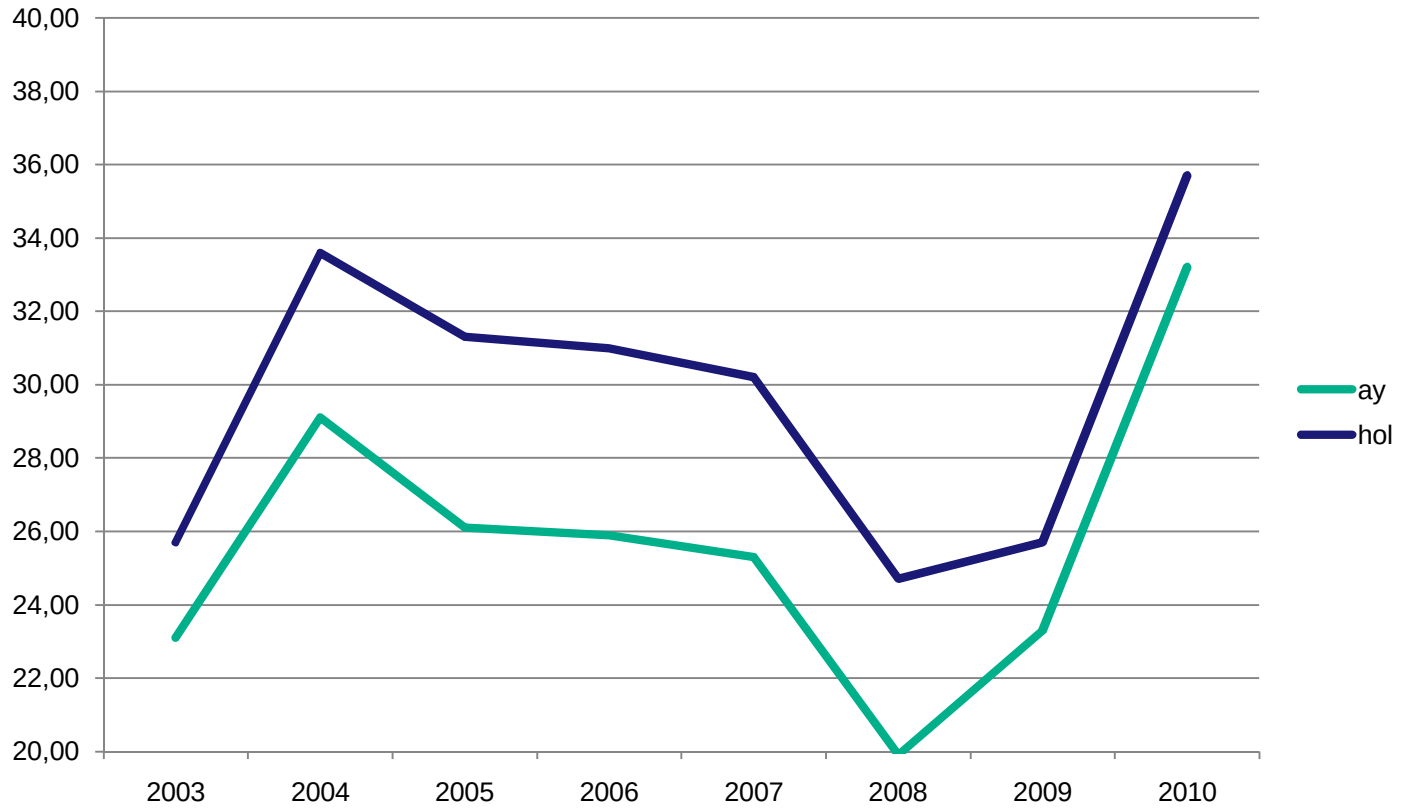
* infectious

Percentage of Holstein cows with claw disorders in 2000-2010

Disorder	Cows, %	Disorder	Cows, %
Sole haemorrhages	19.18	Digital dermatitis	0.10
Chronic laminitis	0.51	Corkscrew claw	2.02
White line separation	5.27	Other claw disorder	0.36
Sole ulcer	1.94	*Preventive treatment = healthy*	68.26
Interdigital dermatitis	0.29	*One or more claw disorders*	31.74
Heel horn erosion	2.06		

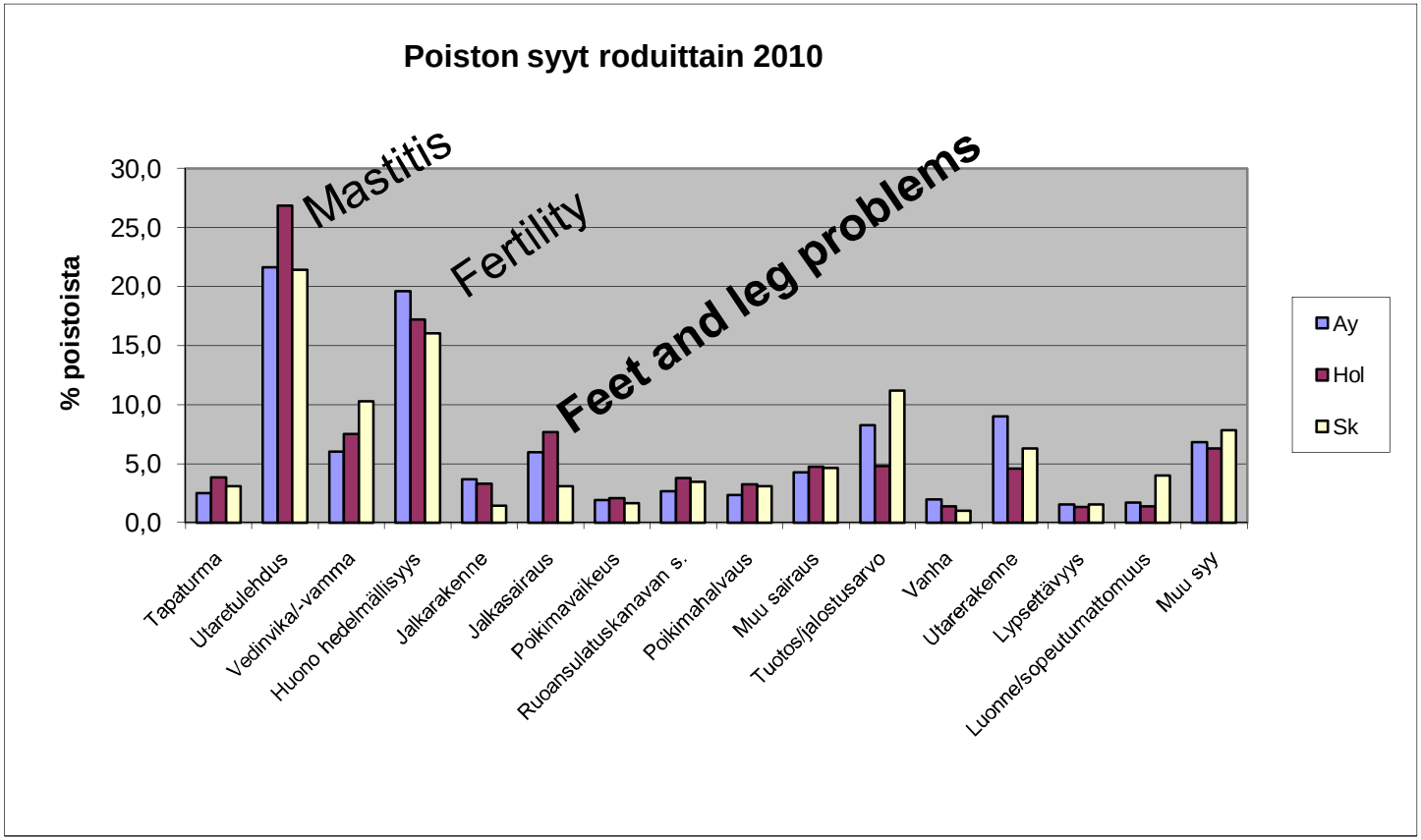
36,581 observations from 19,152 cows

The change in diagnosed cases in 2003-2010



Culling reasons of cows in 2010

Pro Agria milk recording



The aim of the project is to

- Develop automatic lameness detection in a milking robot
- Develop a model to predict the lameness from the early observations with automatic device
  - e.g. acceleration sensor, eating behavior
- Estimate the genetic parameters of claw disorders from field data
- Estimate the genetic correlations of claw disorders with conformation traits
- Construct an index to be used in selection for better claw and foot health

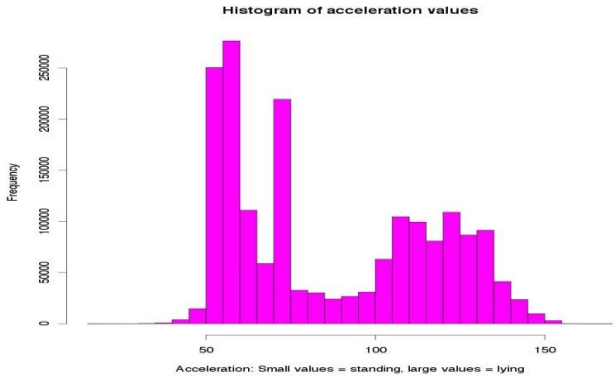
Measuring the lying time

Photo: Petro Tamminen

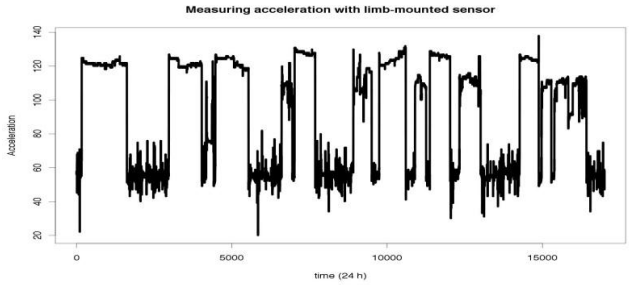
Limb-mounted sensor

Gravitation

- Small values = standing
- Large values = lying



Simple clustering algorithm divides measurements in two groups



24 hours of acceleration data

The CowByte5D- acceleration sensor

Up to 1 km communication range

2600 mAh battery

Battery life time 2 weeks with 60 Hz

Battery life time up to 9 weeks with 1 Hz

3D-accelerate sensor
2D-gyroscope
Microcontoller
869 MHz radio
Up to 60 Hz measuring frequency
1.5 … 6 g measuring range

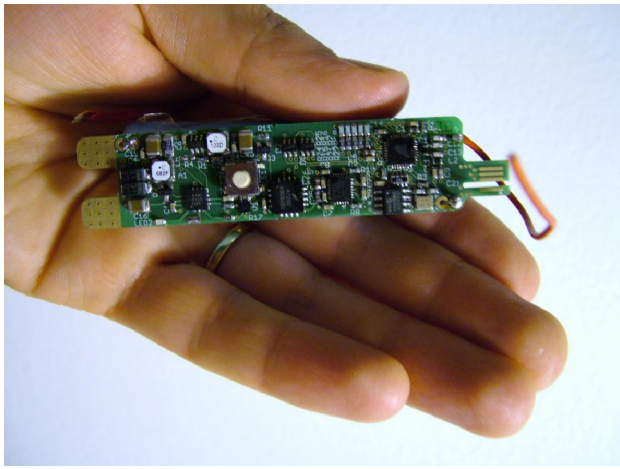


Photo: Petro Tamminen

Testing the sensor

Recording one week of acceleration data from three cows

Behavior was filmed

Photo: Petro Tamminen

The measured lying times for cows during one week were accurate. The average total lying time was 4260 minutes (71 hours) during the one-week experiment. The average error in measurement was +- 11 minutes.

Average lying bout duration was 44 minutes. The average error in measurement was <+- 1 minutes. That is to say, we were able to measure the lying time with over 99 % accuracy.

Measuring the balance of the cow to predict lameness

The Lely robot has a scale, which measures the weight of the animal from 4 corners

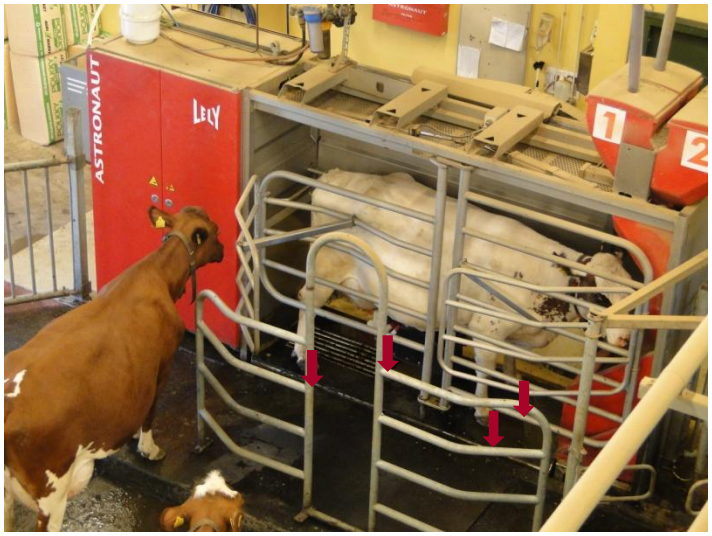


Photo: Jarmo Juga

The aim is to use these measurements to estimate the standing balance of the cow and to predict the early lameness

Starts autumn 2011

Locomotion as a predictor of claw disorders

Locomotion is scored by two evaluators twice in a month using Winckler & Willen scores

Clinical diagnostics are done bimonthly by a veterinarian

- About 50 cows, winter feeding periods 2010-11 and 2011-12

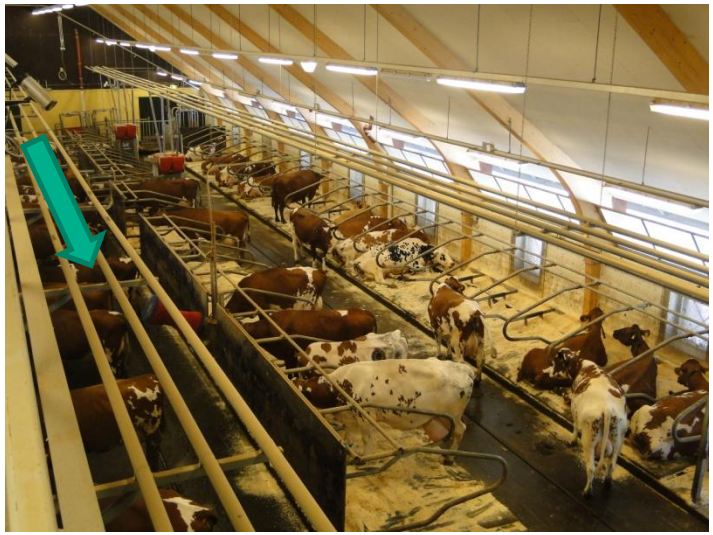


Photo: Jarmo Juga

Effect of different environmental conditions in tie-stall barns and in loose housing system on claw health

- Data between years 2005 and 2009 by hoof trimmers
- Claw disorders were combined into one binomial claw health trait
- Logistic generalized linear model with R
- 12 755 Ayrshire and Holstein cows in 306 loose housed herds
- 18 038 Ayrshire and Holstein cows in 609 tie stall herds
- Breed, parity, year-season, barn_type, feeding_type, bed_surface, bedding_material, outdoor as fixed effects
- Hoof-trimmer and farm (within hoof-trimmer) as random effects

Summarized results

Holstein cows had higher risk of getting claw disorders compared to Ayrshire cows

Older cows had higher risk of getting claw disorders

Farms with flat rate feeding system had more claw disorders than farms which adjusted feeding according to yield

Pasture and winter paddock reduced the incidence risk in both barn types

Genetic parameters for claw health and foot and leg conformation traits in Finnish Ayrshire cows

- Linear logistic model with mixed effects was used for claw health, linear model for foot and leg conformation
- Bivariate animal model with ASREML ver 3.0
- Estimated heritability for claw health using binomial logistic model was 0.07±0.01
  - Heritability estimates for individual disorders 0.01-0.20
- Heritabilities ranged from 0.08 to 0.18 for foot and leg conformation traits
- The genetic correlation between claw health and feet and leg conformation traits ranged from -0.48 to 0.36

Genetic parameters for claw health and foot and leg conformation traits in Finnish Ayrshire cows

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Genetic Evaluation of Claw Health in Denmark, Finland and Sweden

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Future considerations

Analysis of

- Locomotion, lying time, eating behavior and other data from automatic devices as an early predictor of claw disorders
- Lely weigh data?

Finish the analysis of genetic parameters for individual claw problems and their genetic correlation with feet and leg conformation

Estimation of the economic value of claw health

- Comparison to current NTM

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faba

Thank you for your attention