Pathogen-specific production losses in bovine mastitis

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Background

- Mastitis results in substantial problems for animal welfare, food safety, and profitability of milk production
- The safety issues have become more and more important because of the fear over antimicrobial resistance
  - Increases the pressure to reduce antimicrobial drug usage
- Mastitis is the main reason for antimicrobial drug use for dairy cows
- The target is efficient and economic but also safe mastitis control
  - Pathogen-specific information is a prerequisite to provide tools and incentives for responsible mastitis control
    - Milk sampling!
- Long-term milk yield losses constitute a notable share of the economic losses attributable to mastitis

Aim of the study


Photo: Erkki Oksanen

- To investigate pathogen-specific impacts of mastitis on milk production of dairy cows under farm conditions where current mastitis control practices are followed -> economic incentives for mastitis prevention

Data

- Cow-specific data from 20,234 dairy cows in 3,953 dairy farms during the years 2010, 2011, and 2012
- Milk and health recordings and microbiological diagnoses of mastitic quarter milk samples were merged for the investigation
- The six most common udder pathogens were included in the study
  - non-*aureus* staphylococci (NAS), 46.0%
  - *Staphylococcus aureus, 25.5%*
  - *Streptococcus uberis,8.4%*
  - *Streptococcus dysgalactiae,7.9%*
  - *Corynebacterium bovis, 6.7%*
  - *Escherichia coli, 5.6%*
- The information on lactation periods with and without mastitis was collected on the same cow
- The estimated lactation curves were adjusted to describe the cow's third lactation -> comparability of milk yields on lactations free of mastitis and with mastitis

Methods

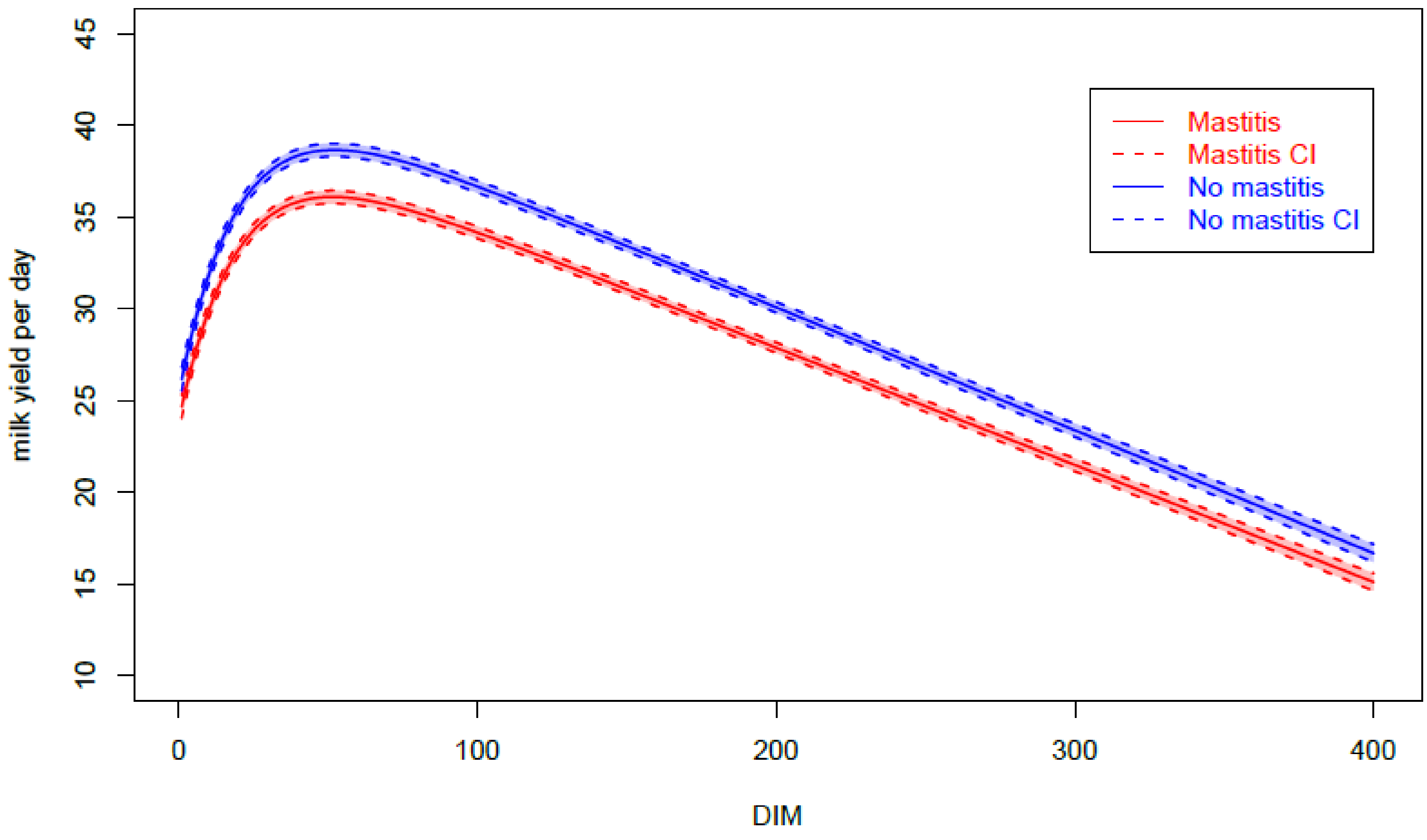
- A two-level (herd, cow) multilevel model was applied
- The model variables were
  - daily milk production (response)
  - time (DIM at which the milk yield was measured)
  - type of mastitis (categorical, two levels)
  - stage (DIM at which the pathogen was discovered in the milk sample; three levels)
  - pathogen (categorical, six levels)
  - dummy status predictor (lactation with or without mastitis)
- A model of a lactation curve was incorporated in the two-level multilevel model
  - a model proposed by Wilmink was chosen

$$y = \beta_0 + \beta_1 \exp(-k \times DIM) + \beta_2 DIM$$

- All the computations were performed with the R Software

Lactation curves for a lactation free of mastitis and with mastitis due to *Staphylococcus aureus*

- Diagnosis at 1 – 53 DIM, clinical mastitis



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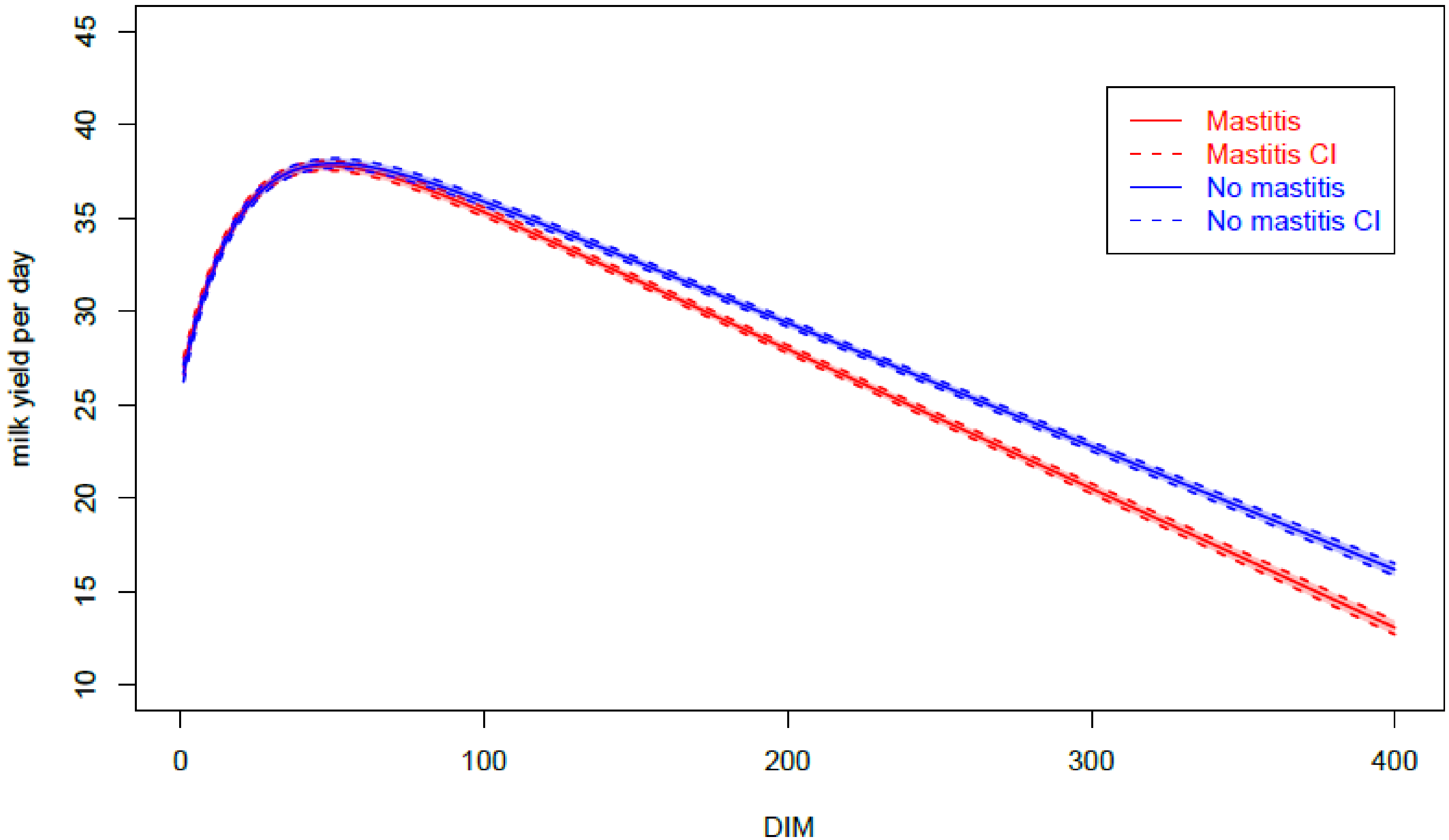
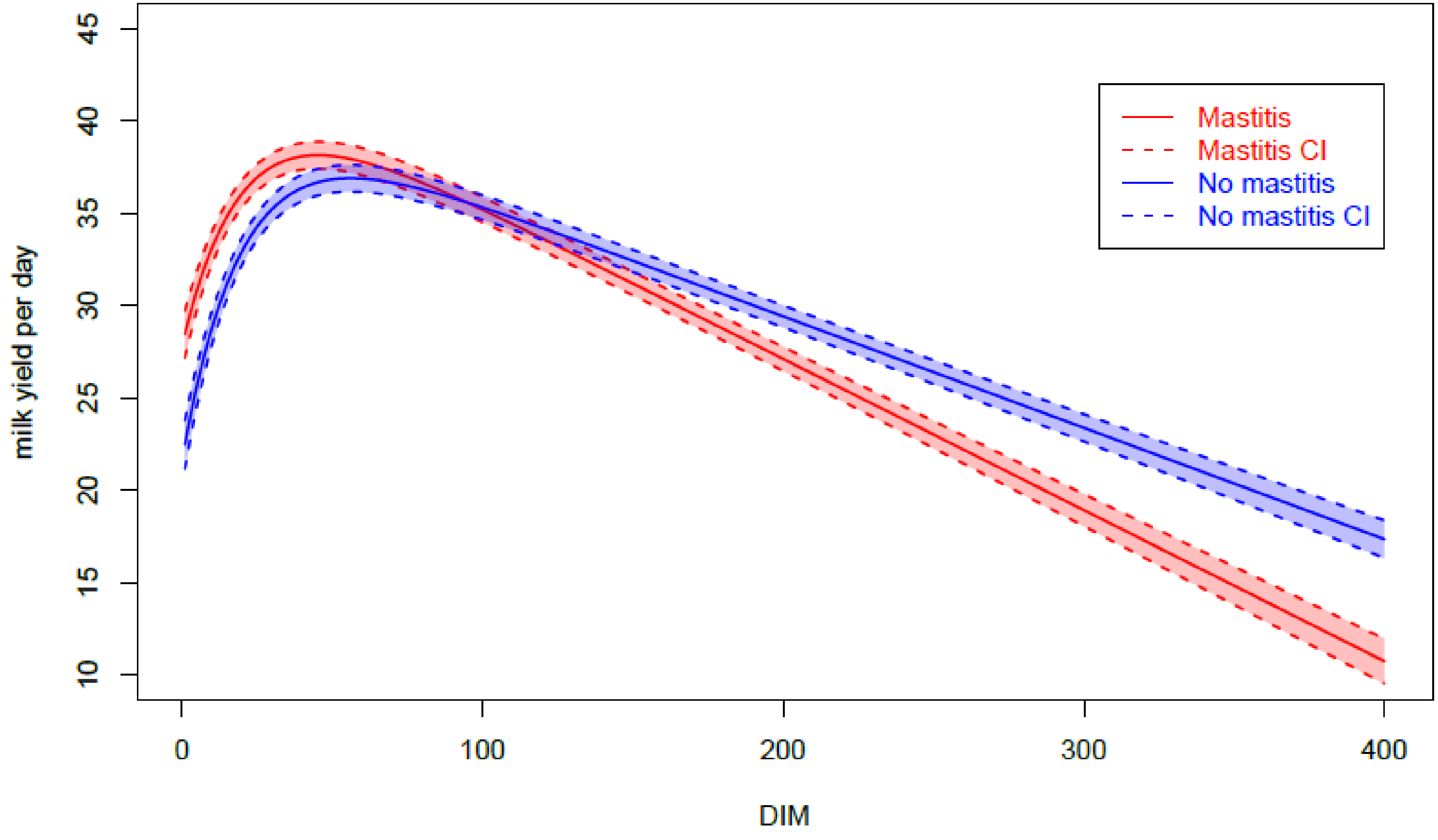
Lactation curves for a lactation free of mastitis and with mastitis due to non-*aureus* Staphylococci

- Diagnosis at 54 - 120 DIM, clinical mastitis



Lactation curves for a lactation free of mastitis and with mastitis due to *Escherichia coli*

- Diagnosis at 54 - 120 DIM, clinical mastitis



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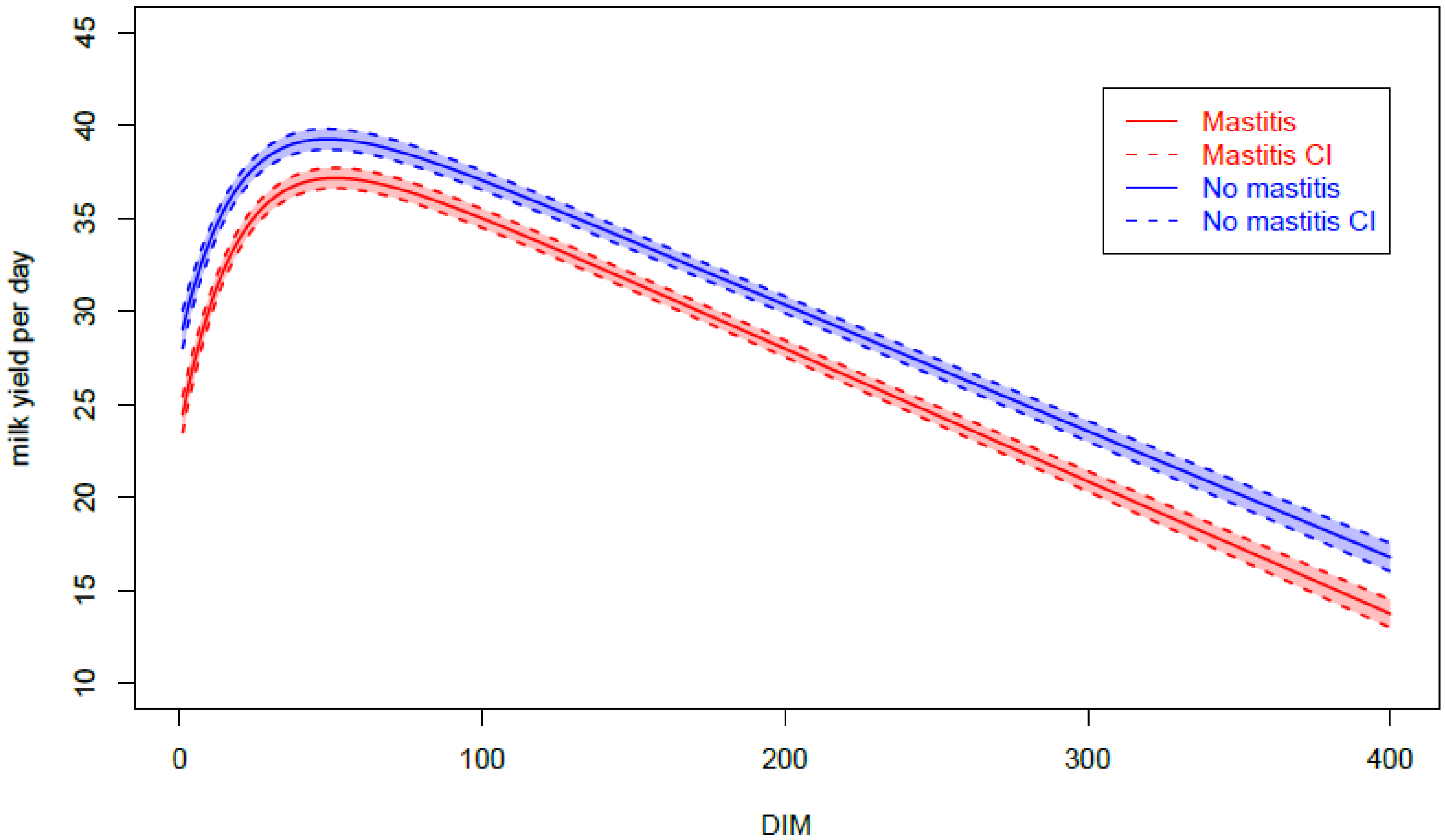
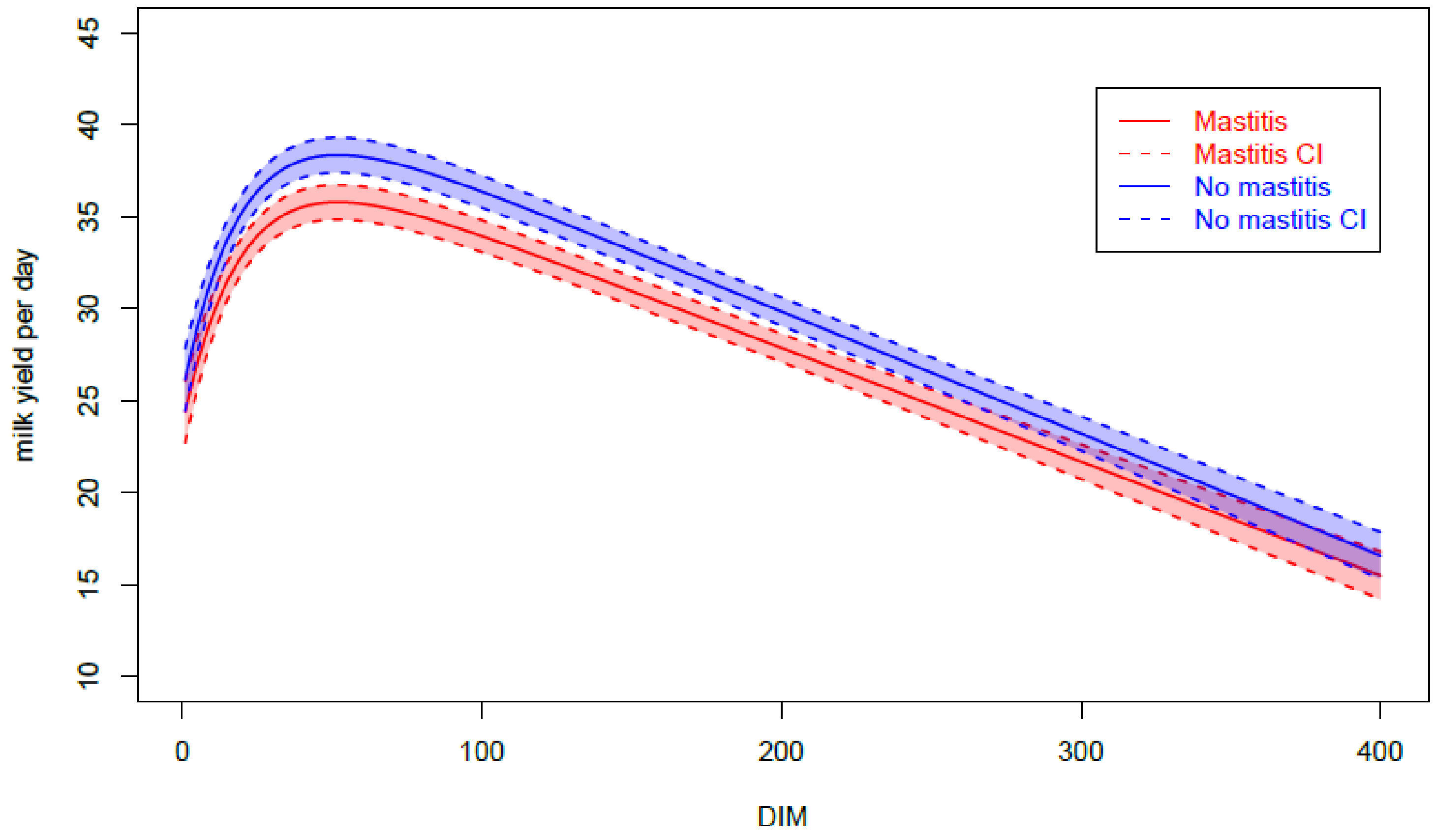
Lactation curves for a lactation free of mastitis and with mastitis due to *Corynebacterium bovis*

- Diagnosis at 54 – 120 DIM, clinical mastitis



Lactation curves for a lactation free of mastitis and with mastitis due to *Streptococcus uberis*
- Diagnosis at 1 – 53 DIM, subclinical mastitis



Pathogen	Significant difference in 305-d yield between lactations with and without mastitis		
Timing[1] and type of mastitis[2]	Milk yield loss, kg	Milk yield loss, %	Milk yield loss, kg/d
Staphylococcus aureus			
Pre peak CM	691	7.1	2.3
Pre peak SCM	674	7.1	2.2
Post 1 CM	423	4.3	1.4
Post 1 SCM	426	4.4	1.4
Non-*aureus* staphylococci			
Pre peak CM	556	5.7	1.8
Post 1 CM	306	3.2	1.0
Escherichia coli			
Pre peak CM	1,053	10.6	3.5
Corynebacterium bovis			
Pre peak CM	731	7.4	2.4
Streptococcus uberis			
Pre peak SCM	645	6.6	2.1
Post 1 CM	407	4.2	1.3
Streptococcus dysgalactiae			
Pre peak CM	623	6.4	2.0
Post 1 CM	355	3.7	1.2

[1]Pre peak = 1–53 DIM;
post 1 = 54–120 DIM;
post 2 = >120 DIM

[2]CM = clinical mastitis;
SCM = subclinical mastitis

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Conclusions

- The minor pathogens (NAS, *C. bovis*) should not be underrated as a cause of production losses
  - NAS are the most common pathogens detected in Finnish dairy herds
  - May cause clinical mastitis and, as such, production losses
- On single dairy farms, getting rid of environmental pathogen *E. coli* would bring a significant increase in milk production
  - Rare pathogen but cause significant production loss
- Reducing *Staph. aureus* mastitis is the biggest challenge for the Finnish dairy sector
  - Common pathogen which cause moderate production loss both as clinical and subclinical mastitis

Thank you

Photo Erkki Oksanen

More information

- A.-M. Heikkilä, E. Liski, S. Pyörälä, and S. Taponen. 2018. Pathogen-specific production losses in bovine mastitis. Journal of Dairy Science 101 (in press). https://doi.org/10.3168/jds.2018-14824

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