Identification and evaluation of novel fertility traits using automated activity monitor data from commercial dairy herds

C.A. Rosenberg[1], D.F. Cardoso[1], F. Malchiodi[2], F.S. Schenkel[1], C.F. Baes[1,3]

[1]Center for Genetic Improvement of Livestock, University of Guelph, Guelph, ON, Canada; [2]Semex Alliance, Guelph, ON, Canada; [3]Institute of Genetics, Vetsuisse Faculty, University of Bern, Bern, Switzerland

Introduction

- Genetic progress for fertility has been limited by low trait heritability and management effects

- Incorporation of automated sensor technologies has provided new opportunities to identify novel traits

- Sensor-based measurements of estrus expression have been associated with fertility outcomes

Objective

To estimate genetic parameters for estrus-related traits based on automated activity monitor (**AAM**) data from commercial dairy herds

Evaluated Traits

- **CFDH**: Interval from Calving to First Detected Heat (*days*)

- **ED**: Estrus Duration (*hours*)

- **ES**: Estrus Strength (*index score*)

- **NRH56**: 56-day Non-Return Heat Rate
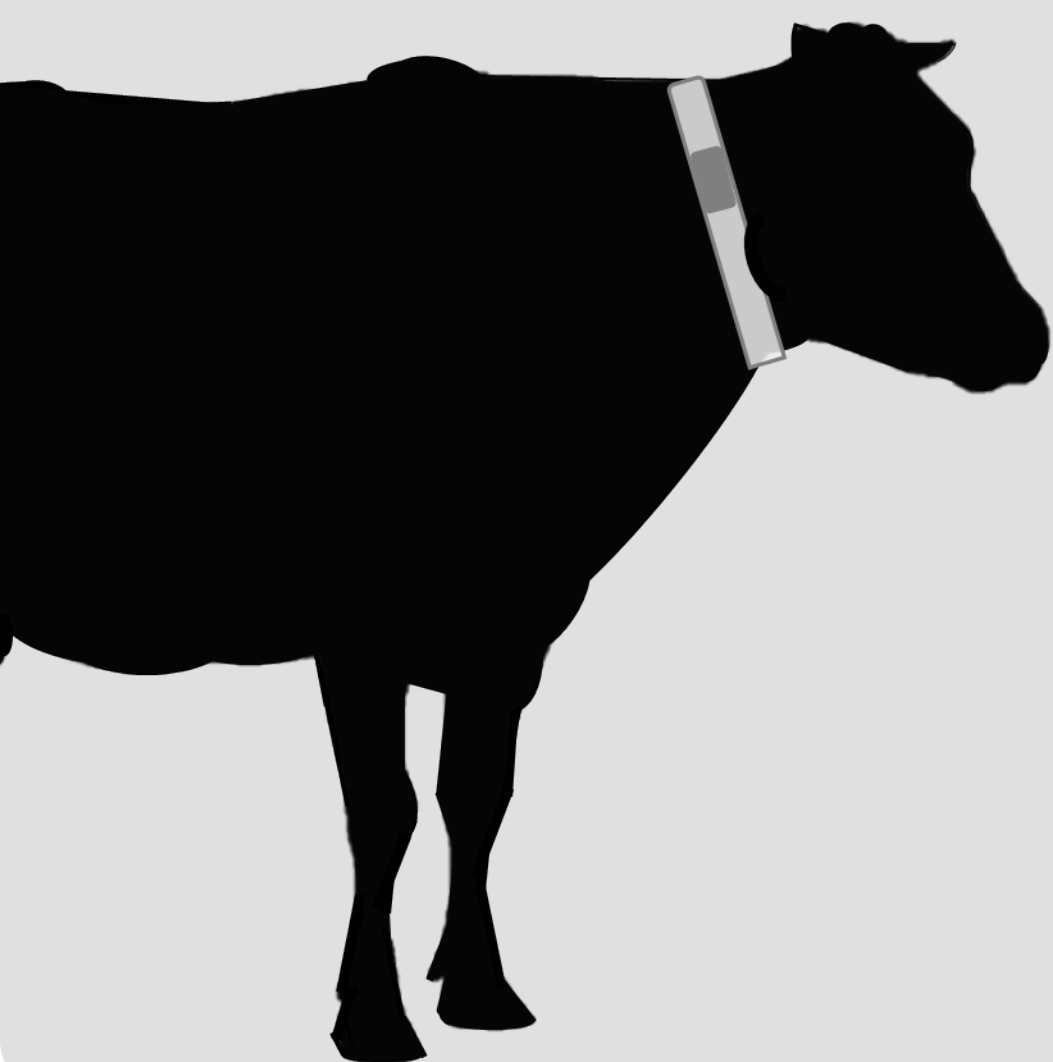
Materials & Methods

- Data consisted of AAM and breeding records for lactating cows from three herds collected between 2018 – 2020

- Estrus-related traits were derived from fertility index scores **≥ 30** generated by the Allflex Heatime® System

- Univariate analyses performed using BLUPF90

Animal Model:

$$y_{ijklm} = h_i + p_j + ys_k + a_l + pe_m + e_{ijklm}$$

Fixed Effects   *Random Effects*

Where:
h_i is herd (i = 1 to 3)
p_j is parity (k = 1,2,3, ≥ 4)
ys_k is year-season of estrus episode (j = 1 to 9); year-season of calving for NRH56 (j = 1 to 9)

Where:
a_l additive genetic effect
pe_m permanent environmental effect
e_{ijklm} residual effect

Results

Table 1. Descriptive statistics for estrus-related traits

Trait	N. of cows	N. of records	Mean	SD	Min.	Max.
CFDH	4,968	6,074	78.5	67.9	15.0	211.0
ED	4,968	21,087	47.2	9.7	2.0	83.0
ES	4,968	21,087	78.0	18.8	32.0	97.9
NRH56	4,623	5,522	0.5	0.5	0.0	1.0

Table 2. Additive genetic variance σ^2_a, permanent environmental variance σ^2_{pe}, residual variance σ^2_e, and heritability (h^2) with standard error in parenthesis for estrus-related traits

Trait	σ^2_a	σ^2_{pe}	σ^2_e	h^2
CFDH	281.82	0.24E-04	3910.90	0.067 (0.01)
ED	3.48	5.31	84.15	0.037 (0.01)
ES	14.28	22.19	312.52	0.041 (0.01)
NRH56	0.04	0.02	1.00	0.037 (0.02)

Conclusions

- Heritability estimates were low but comparable to those of existing fertility traits

- Fertility index scores from AAM systems can be used to define estrus-related traits

- Analyses using larger datasets will be performed to evaluate the potential application of these traits