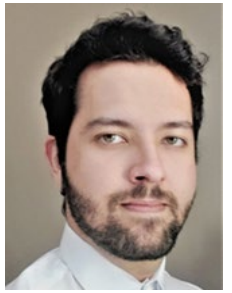
THE Resilient Dairy GENOME PROJECT

ICAR 2022 - Montreal
May 30th - June 3rd



Estimates of genetic parameters for environmental efficiency traits for first lactation Holsteins

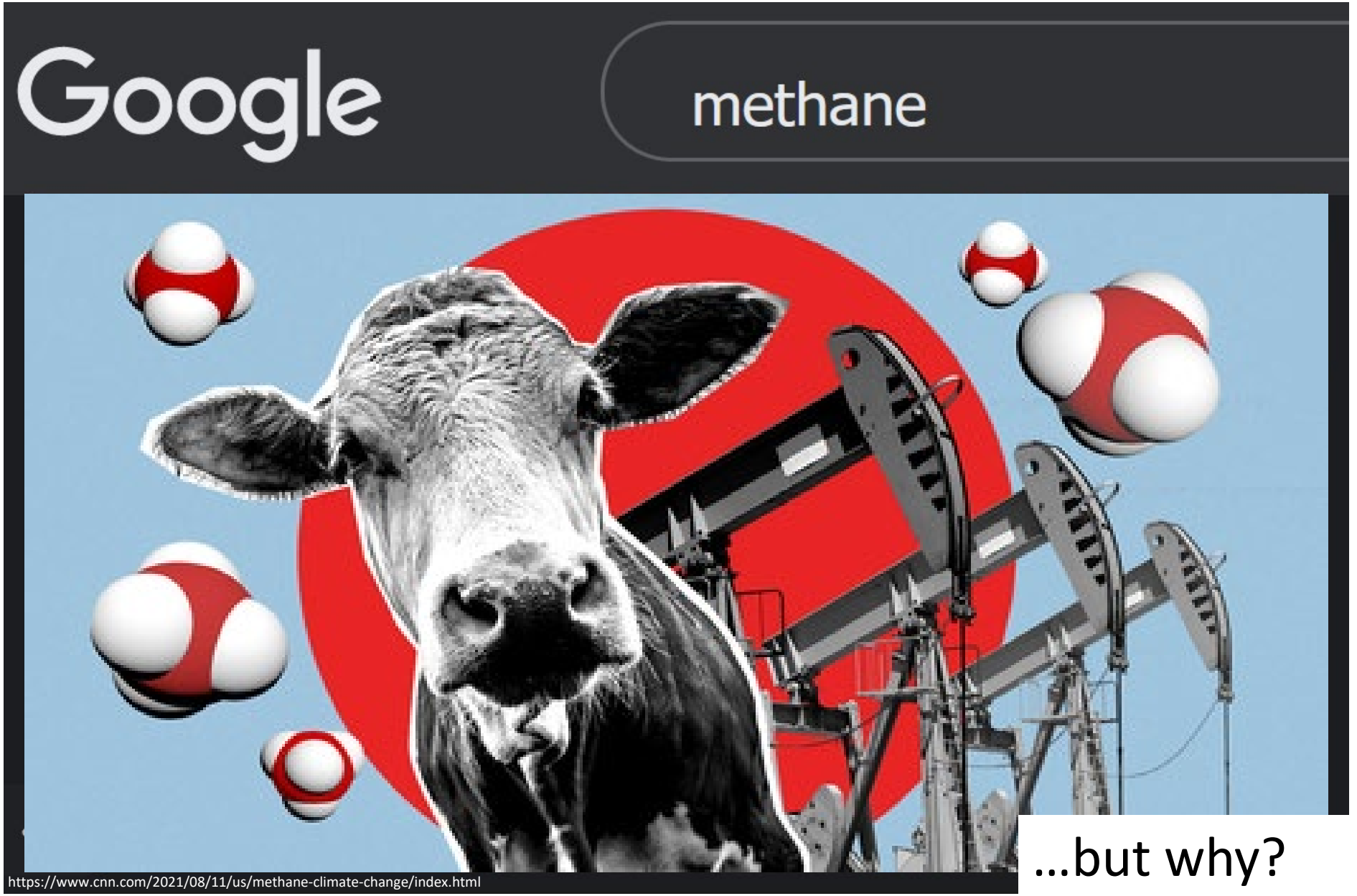
L.S.F. Lopes[1], K. Houlahan[1], F.S. Schenkel[1], D. Tulpan[1], F. Miglior[1,2], M. Sargolzaei[3,4], J.E. Koltes[5], & C.F. Baes[1,6]

[1]Centre for Genetic Improvement of Livestock, Department of Animal Biosciences, University of Guelph, N1G 2W1, Guelph, Ontario, Canada
[2]Lactanet, N1K 1E5, Guelph, Ontario, Canada
[3]Ontario Veterinary College, University of Guelph, N1G 2W1, Guelph, Ontario, Canada
[4]Select Sires Inc, 43064, Plain City, Ohio, United States of America
[5]Department of Animal Science, Iowa State University, 50011-3150, Ames, Iowa, United States of America
[6]Institute of Genetics, Vetsuisse Faculty, University of Bern, 3012 Bern, Switzerland

UNIVERSITY of GUELPH
IMPROVE LIFE.

CGIL

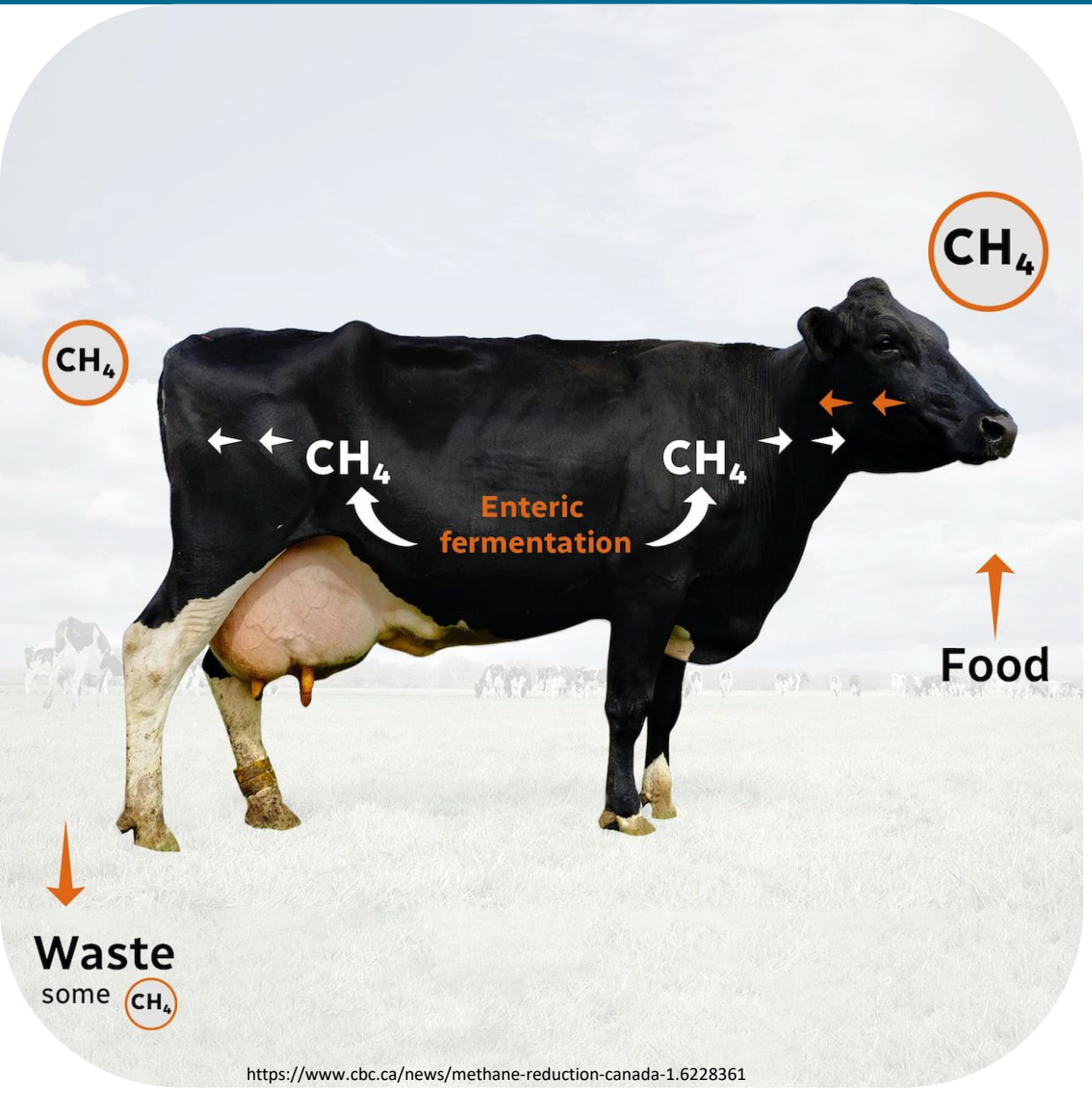
DAIRY at GUELPH
CANADA'S DAIRY UNIVERSITY



https://www.cnn.com/2021/08/11/us/methane-climate-change/index.html

…but why?

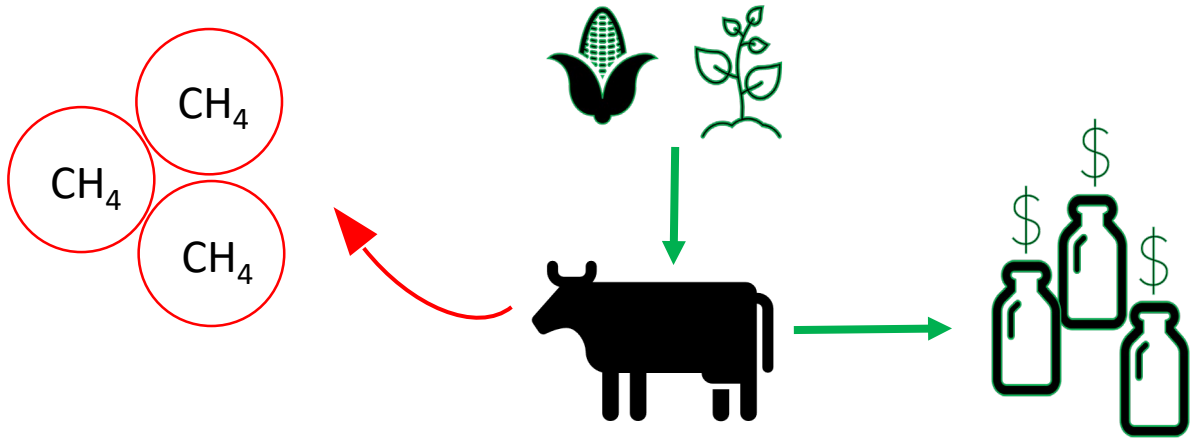
Background



https://www.cbc.ca/news/methane-reduction-canada-1.6228361

- Livestock = 14% of global GHG emissions (Gerber et al., 2013)
- Enteric methane (CH_4) = 6% of global GHG emissions (Gerber et al., 2013)

Background



lower emissions = higher efficiency

Gas = 10% loss of dietary energy (de Haas et al., 2011)

- Excessive gas means low efficiency
- Impacts profitability

Background

Complexity of measuring

- Methane and feed efficiency
- Lower methane = sustainability

Indicator traits

- Indirect selection/progress of target traits
- Need to be heritable and genetically correlated

Rumination time as candidate

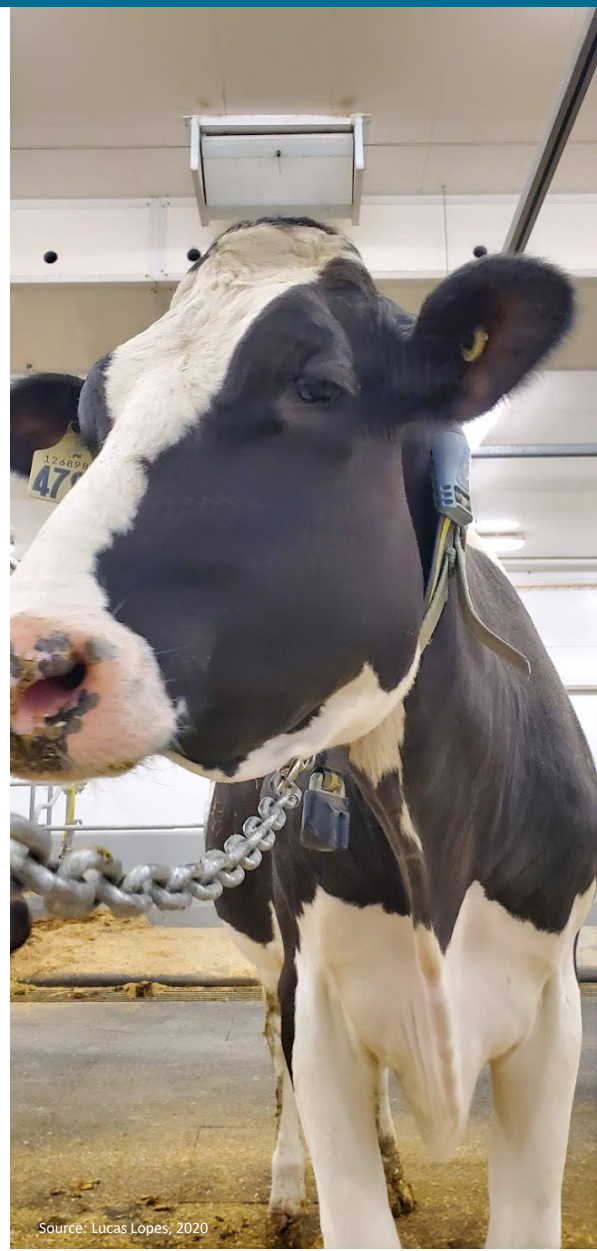
Rumination related to:

- Feeding behaviour (intake and digestion)
- Ruminal fermentation (gas production)

Automatically recorded rumination time (RT)

- Health (Soriani et al., 2012)
- Reproduction (Reith & Hoy, 2012)
- Production (Kaufman et al., 2018)

https://www.profitablemilk.com/wp-content/uploads/2018/03/Heatime2018.pdf



Source: Lucas Lopes, 2020

Objectives

Evaluate the use of automatically recorded rumination time as an indicator of efficiency and sustainability by:

Estimating heritability

Genetic correlations:

- Rumination Time
- Methane emission
- Feed efficiency
- Production

Material and Methods

Ontario Dairy Research Centre

656 first lactation Holstein cows

Phenotypes

- Rumination time (RT): minutes/day (Allflex®)
- Methane (CH_4): g/day (GreenFeed®)
- Methane yield (MeY): CH_4/DMI
- Methane intensity (MeI): CH_4/ECM
- Feed efficiency (FE): phenotype from genetic covariances (DMI, ECM and MBW)
- Energy corrected milk (ECM): 0.25 x milk + 12.2 x fat + 7.7 x protein
- MBW: body weight$^{0.75}$

Model

$$Y_{ijklm} = \mu + AC_i + WL_j + YS_k + a_l + pe_m + e_{ijklm}$$

Where:

Y_{ijklm} = phenotype

μ = overall mean of the trait

AC_i = fixed effect of age at calving (eight levels)

WL_j = fixed effect of the week of lactation (thirteen levels)

YS_k = fixed effect of the year and season of calving (sixteen levels)

a_l = random additive genetic effect

pe_m = random permanent environmental effect (for FE, DMI, ECM, and MBW)

e_{ijklm} = random residual error term

Results

Heritabilities on the diagonal, and genetic correlations above the diagonal

	RT	CH_4	MeY	MeI	FE	DMI	ECM	MBW
RT (min/day)	**0.48 (0.14)**	-0.45(0.25)	NA	-0.88 (0.24)	-0.08 (0.19)	0.17 (0.14)	0.48 (0.12)	-0.24 (0.13)
CH_4 (g/day)		**0.42 (0.12)**	0.85 (0.50)	0.48 (0.23)	0.13 (0.18)	0.81 (0.10)	0.76 (0.14)	0.67 (0.10)
MeY (g/kg)			**0.12 (0.10)**	0.84 (0.62)	-0.91 (0.24)	-0.92 (0.12)	-0.37 (0.29)	0.04 (0.29)
MeI (g/kg)				**0.36 (0.13)**	0.04 (0.22)	-0.17 (0.16)	-0.81 (0.08)	0.66 (0.13)
FE (kg)					**0.13 (0.07)**	0.69 (0.14)	-0.06 (0.29)	-0.08 (0.30)
DMI (kg)						**0.24 (0.07)**	0.56 (0.17)	0.40 (0.21)
ECM (kg)							**0.32 (0.07)**	-0.01 (0.21)
MBW ($kg^{0.75}$)								**0.44 (0.11)**

Rumination Time

	CH_4	MeI	FE	DMI	ECM
RT (min/d)	-0.45(0.25)	-0.88 (0.24)	-0.08 (0.19)	0.17 (0.14)	0.48 (0.12)

RT for lowering emission per kg of milk

- Increase in intake
- Physiological limit with intake

Methane

	FE	DMI	ECM
MeI (g/kg)	0.04 (0.22)	-0.17 (0.16)	-0.81 (0.08)

Lower methane intensity

- Higher intake
- Higher production
- Same efficiency

Conclusions

Rumination time was heritable

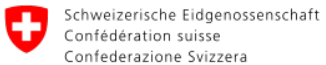
Increase in rumination time was correlated with:

- Decrease in methane emissions
- Increase in milk production

More studies are necessary to validate these findings

Acknowledgements

THE Resilient Dairy GENOME PROJECT



Thanks

THE
Resilient Dairy
GENOME PROJECT

Lucas Lopes
llopes@uoguelph.ca