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# Modelling performance consequences on the probability of reproducing, and thereby on productive lifespan in dairy cows

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## Production, Management, and the Environment III

**683 Analyzing the rear shape of dairy cows in 3D to better assess body condition score.** Amélie Fischer<sup>\*1,2</sup>, Thibault Luginbühl<sup>3</sup>, Laurent Delattre<sup>3</sup>, Jean-Michel Delouard<sup>3</sup>, and Philippe Faverdin<sup>1</sup>, <sup>1</sup>INRA/Agrocampus-Ouest UMR 1348 Pegase, St-Gilles, France, <sup>2</sup>Institut de l'élevage, Le Rheu, France, <sup>3</sup>D'Ouest, Lannion, France.

Body condition is an important trait in dairy cow management, mainly because it reflects the level and the use of body reserves and indirectly reproductive and health performance. Body condition score (BCS), which is done visually or by palpation, is the usual method on farm but is subjective and not very sensitive. The aim was here to develop and to validate 3DBCS which estimates BCS from 3D-shapes of dairy cows rear, the body area commonly used to assess BCS. For the calibration, a set of 57 3D-shapes from 56 Holstein cows with large BCS variability (0.5 to 4.75 on a 0–5 scale) were transformed with a principal component analysis (PCA). A multiple linear regression was fitted on the principal components to assess BCS. Four anatomical landmarks were extracted to normalize the 3D-shapes: the validation results of a manual labeling proved the concept. Then an automated labeling method was developed to extract them. Prior to the PCA, the 3D-shapes were either regularized to fill in the holes or not regularized. External validation was evaluated on 2 sets: one with cows used for calibration, but with a different lactation stage (valididem) and one with cows not used for calibration (validdiff). Repeatability was estimated with 6 cows scanned 8 times each the same day. The automated method performed slightly better than manual method for external validation (RMSE = 0.27 versus 0.34 for validdiff) and both were more repeatable than usual BCS ( $\sigma = 0.20$  for 3DBCS and 0.28 for BCS). Surprisingly, regularizing the 3D-shapes performed slightly less than without regularization. Nevertheless regularization should be an interesting process before BCS assessing, especially to avoid discarding too many 3D-shapes. The first results of 3D-BCS monitoring in dairy cows with a fully automated method show promising results in terms of phenotyping. The next step will try to reduce scanning time to decrease the number of bad 3D-shapes due to cow's movement without losing too much resolution.

**Key Words:** body condition score, 3D imaging, principal component analysis

**684 Modelling performance consequences on the probability of reproducing, and thereby on productive lifespan in dairy cows.** Ho N. Phuong<sup>1,3</sup>, Pierre Blavy<sup>1,3</sup>, Olivier Martin<sup>1,3</sup>, Luc Delaby<sup>2,4</sup>, Philippe Schmidely<sup>1,3</sup>, and Nic C. Friggens<sup>\*1,3</sup>, <sup>1</sup>INRA UMR MoSAR, Paris, France, <sup>2</sup>INRA UMR PEGASE, Rennes, France, <sup>3</sup>AgroParisTech, Paris, France, <sup>4</sup>AgroCampusOwest, Rennes, France.

Reproductive success is a key component of lifetime efficiency (ratio of total energy in milk to total energy intake over the lifespan) as failure to get in calf results in culling and thus has a negative effect on productive lifespan. At the animal level, breeding and feeding management can substantially affect milk yield, body condition, and energy balance of cows, which are all major contributors to reproductive failure in dairy cattle. This study developed a reproductive module that was incorporated into an existing lifetime performance model to enable prediction of the performance consequences of different breeding and feeding strategies on probability of reproducing, and thereby on productive lifespan. This then allows more realistic prediction of cow lifetime efficiency. The model is dynamic and stochastic with an individual cow being the

unit of modeling and one day being the unit of time. To evaluate the reproductive module, data from a French study including Holstein and Normande cows fed with high concentrate diet and data from a Scottish study including Holstein cows selected for high and average genetic merit for fat plus protein, fed with high versus low concentrate diets were used. On average, the model consistently simulated reproductive performance of various genotypes of cow across feeding systems. Relative to the French data, the model significantly under-predicted first service conception rate for Normande cows (48% vs. 58% for predicted vs. observed). On the Scottish data, simulated conception to first service was not significantly different from observed but interval traits (days to first service, days open) were under predicted, which was mainly due to the discrepancy between simulated and observed voluntary waiting periods. Simulation showed that genetic selection for greater milk production impaired reproductive performance and thus reproductive lifespan, but not lifetime efficiency. However, the definition of lifetime efficiency used did not include associated costs or consider herd-level effects, which should be included to allow more accurate simulation of lifetime profitability in different scenarios.

**Key Words:** dairy cow, lifetime efficiency, productive lifespan

**685 Modeling the effect of forage allowance, forage mass, and body condition on calf weaning weight and calving conception interval of primiparous cows grazing Campos grasslands.** Martín Claramunt<sup>\*1</sup>, Mariana Carriquiry<sup>2</sup>, and Pablo Soca<sup>3</sup>, <sup>1</sup>Facultad de Veterinaria, Universidad de la República, Paysandú, Paysandú, Uruguay, <sup>2</sup>Facultad de Agronomía, Universidad de la República, Montevideo, Montevideo, Uruguay, <sup>3</sup>Facultad de Agronomía, Universidad de la República, Paysandú, Paysandú, Uruguay.

The relationships among forage allowance (FA), forage mass (FM), and BCS during early (E) and middle gestation (M), calving (C) and lactation (L), and calf weight at weaning and calving conception interval (CCI) were studied employing records from an experiment that evaluated the effect 2 levels of FA on productivity of primiparous beef cows grazing Campos grassland. The study took place in Facultad de Agronomía, Uruguay (31°S 57°W). Eighty primiparous cows were assigned to a completely randomized experiment of 2 FA in spatial replication on 2 blocks during 2 years. The experiment started in autumn –150 d postpartum (dpp; early gestation [e]) and finished 190 dpp. Annual FA averaged 2.5 and 4 kg DM/kg liveweight (LW) for low (L) and high (H) FA, respectively. Cow LW and FM were measured monthly to adjust FA using the “put and take” method. The BCS was recorded (1–8 points scale). Calf birth weight (CBW) and weaning weight were recorded and calf weight adjusted at 205 d (CW) of age was estimated. Date of subsequent calving was recorded and CCI was calculated subtracting 285 d of gestation. Models were obtained by multiple regressions selected by Stepwise procedure (JMP 6.0). The BCSe, FAm, FMI, BCSe×FMI and CBW explain CW ( $CW = -8.6 + (13 \times BCSe) + (4.9 \times FAm) + (0.036 \times FMI) + (1.8 \times CBW) - [0.024 \times (BCSe - 5.6) \times (FMI - 1400)]$ ) ( $r^2 = 0.54$ ;  $P < 0.01$ ; Mean = 187; RMSE = 15). An increase in one unit of BCSe, FAe, and FMI increase CW in 13, 4.9 and 0.036 kg respectively. The interaction BCSe×FMI showed an increase in CW when BCSe increases, in FMI levels below 2000 kg DM/ha without effect on greater values. The CCI was affected by BCSe, Julian calving day (CD) and their interaction ( $CCI = 191 - (8.6 \times BCSe) - (0.6 \times CD) + \{0.4 \times [(BCSe - 4.5) \times (CD - 56)]\}$ ) ( $r^2 = 0.39$ ;  $P < 0.01$ ; Mean = 121; RMSE = 14). The BCSe mainly explains the CCI confirming his value to predict the reproductive response. Those